THE INSTITUTION OF PRODUCTION ENGINEERS JOURNAL

BER 1957

THE INSTITUTION OF

PRODUCTION ENGINEERS JOURNAL

10 CHESTERFIELD STREET . LONDON . W1 Telephone : GROsvenor 5254/9

Vol. 36, No. 12 *Price 10/-* *December 1957*

CONTENTS

THE ANNUAL DINNER, 1957. Addresses by Sir John Maud, G.C.B., C.B.E., and The Rt. Hon. The Earl of Halsbury, F.R.I.C., F.Inst.P., M.I.Prod.E. 743

"COMPRESSED AIR — A USER'S EXPERIENCE" by John Smedley and W. G. Wood 749

"SOME ASPECTS OF AUTOMATION" by A. L. Stuchbery, M.I.Prod.E., M.I.Mech.E. 755

"TOOLING FOR PRECISION PRESSWORK" by J. Galway 760

"MEASURING AND FORECASTING COST DATA IN HIGHLY VARIABLE PRODUCTION" by A. G. Thompson, B.Sc., A.M.I.C.E. 771

REPORT OF THE MEETING OF COUNCIL — 31st October, 1957 786

ELECTIONS AND TRANSFERS 788

EXTRACTS FROM REGION AND SECTION REPORTS 790

INSTITUTION NOTES 795

NEWS OF MEMBERS 796

HAZLETON MEMORIAL LIBRARY — Reviews 797

JOURNAL CONTENTS — Volume 36, 1957 798

INDEX TO PAPERS, 1957 800

The Institution of Production Engineers does not accept responsibility for any statements made or opinions expressed in any papers published in the Journal of the Institution.

EDITORIAL COMMITTEE

John Mitford Brice — Chairman

The Rt. Hon. The Earl of Halsbury — President of the Institution

H. G. Gregory — Chairman of Council

A. A. Francis

H. Peter Jost

J. C. Z. Martin

M. J. Sargeaunt

H. G. Shakeshaft

P. Spear

B. E. Stokes

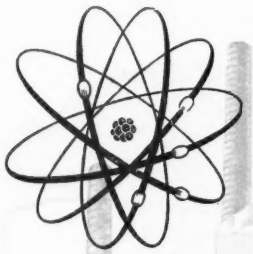
H. J. C. Weighell

EDITOR

M. S. C. Bremner

SECRETARY OF THE INSTITUTION

W. F. S. Woodford



There's power in the atom . . .

Sand cast in aluminium alloy. Diameter 49¼", maximum depth 19¼", fettled weight 536 lb.

and strength in BIRMAL

This is a very special casting. Somewhere behind the creation of atomic power it has an important part to play in the production and processing of fuel. Birmal excel in large complex castings of this kind for both the atomic and the engineering industries. A background of more than half a century's experience lies behind their choice of materials and processes. The benefits of this knowledge and experience are available to all industries where the quality of castings count.

You get more than a casting from BIRMAL

Birmingham Aluminium Casting (1903) Co. Ltd.

BIRMID WORKS SMETHWICK BIRMINGHAM 40

DSG

for even greater efficiency – the improved...

13" swing PRECISION LATHE (13-1)

➡ MULTI PLATE CLUTCHES GIVE FORWARD & REVERSE SPEEDS.

➡ MOTOR HOUSED IN BASE SAVES FLOOR SPACE.

➡ COARSE PITCH & FINE FEED RATIOS.

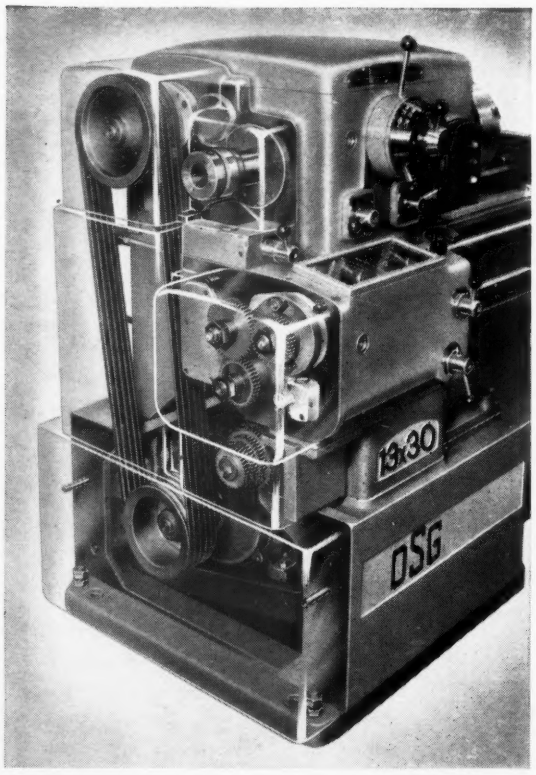
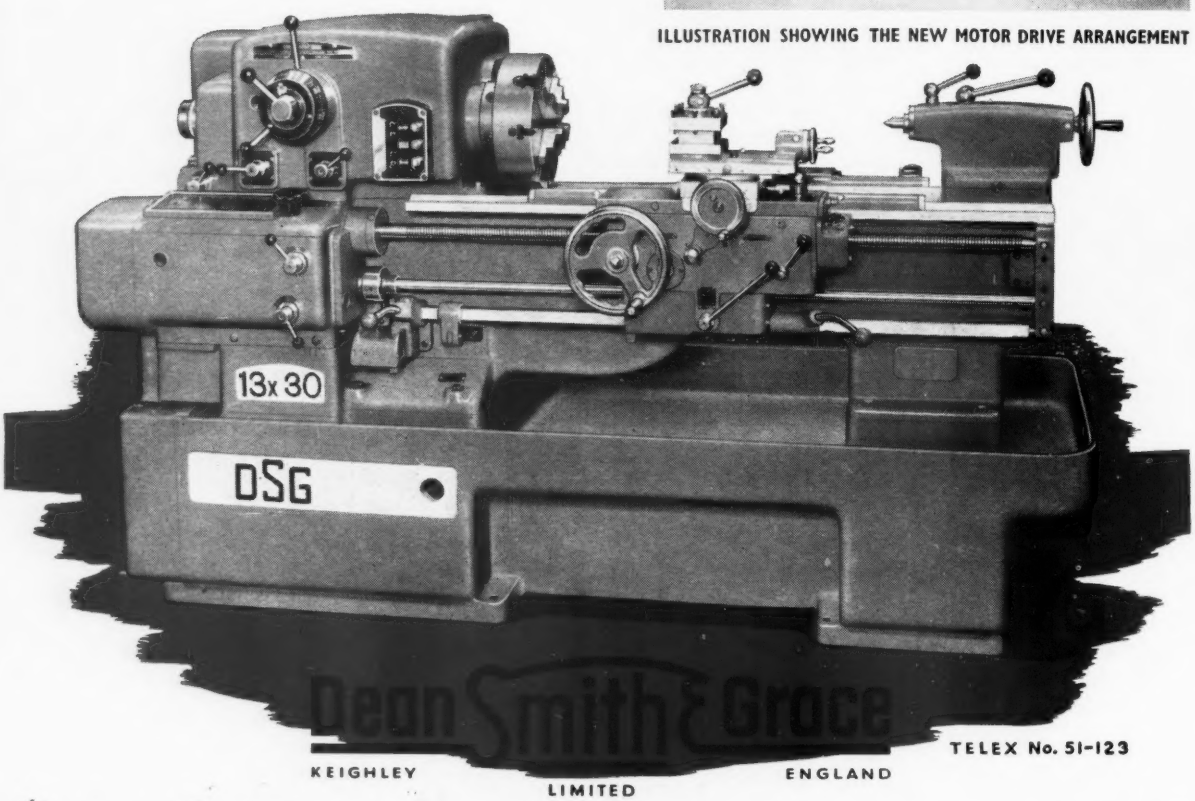


ILLUSTRATION SHOWING THE NEW MOTOR DRIVE ARRANGEMENT



Dean Smith & Grace

KEIGHLEY LIMITED ENGLAND

TELEX No. 51-123

We manufacture: 13-30" SWING ENGINE LATHES • SURFACING AND BORING LATHES • TOOLROOM LATHES

DESCRIPTIVE LEAFLET SENT ON REQUEST

Speaking from Experience

Every CARBORUNDUM representative has been chosen as a member of a team: chosen for his engineering knowledge, his appreciation of manufacturers' problems, and his understanding of production methods. He can speak from the combined experience of the whole team. From his knowledge of products by CARBORUNDUM he can assist you to get the best results and the fastest rates of production. He will never overclaim, because he knows that only a completely satisfied user will buy products by CARBORUNDUM again. So if you have a production problem, send for a CARBORUNDUM representative. His advice will be worth listening to: he speaks with the authority of a team of engineers that is helping to increase industrial efficiency throughout the world.

Specialist advice is part of the **CARBORUNDUM** *service to industry*

Products by CARBORUNDUM

TRADE MARK

THE CARBORUNDUM COMPANY LIMITED · TRAFFORD PARK · MANCHESTER 17 PHONE: TRAFFORD PARK 2301

THE *Bison* FOR PRECISION PROFILE CUTTING

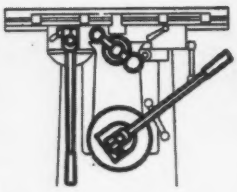
THE BISON profile cutting machine combines versatility with a high degree of accuracy. It can carry up to three cutting heads and is available in two main cutting widths; also, the longitudinal cut can be extended by adding extra sections of track. Interchangeable tracing heads enable work to be carried out from wood or steel templates or drawings, making it suitable for repetition work or the one-off job. Whether using acetylene, propane or coal gas, precise regulation of the cutting speed ensures the highest degree of accuracy and eliminates further preparation before welding. The Bison is giving perfect results on a wide variety of work in industry. For further information please contact your nearest British Oxygen sales office.

Our illustration shows the Bison in action at the works of Messrs. Sale, Tilney & Company Ltd., Wokingham, Berks.

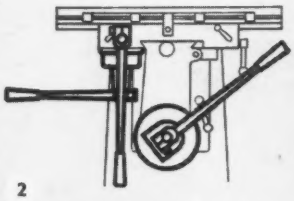
BOC BRITISH OXYGEN

British Oxygen Gases Ltd., Industrial Division, Spencer House, 27 St. James's Place, London, S.W.1.

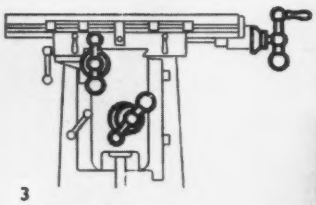
M·C
serving industry
and the community
As members of a community, we are dependant on one another. Our whole organisation is based on this simple fact. The renowned M & C Sales and Technical service is our contribution to the urgent day to day needs of British Industry.
Monks & Crane Ltd
M·C TRADE MARK
BRITAIN'S FOREMOST DISTRIBUTORS
BIRMINGHAM · LONDON · MANCHESTER · GLASGOW · NEWCASTLE ON TYNE
SM/MC 2777



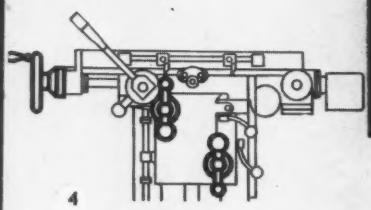
1
Hand Feed—lever, screw, lever.



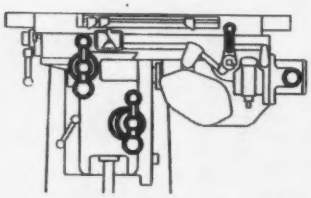
2
Hand Feed—lever, lever, lever.



3
Hand Feed—Screw, screw, screw.



4
Multiform—semi-automatic cycle.



5
Automatic Cycle.

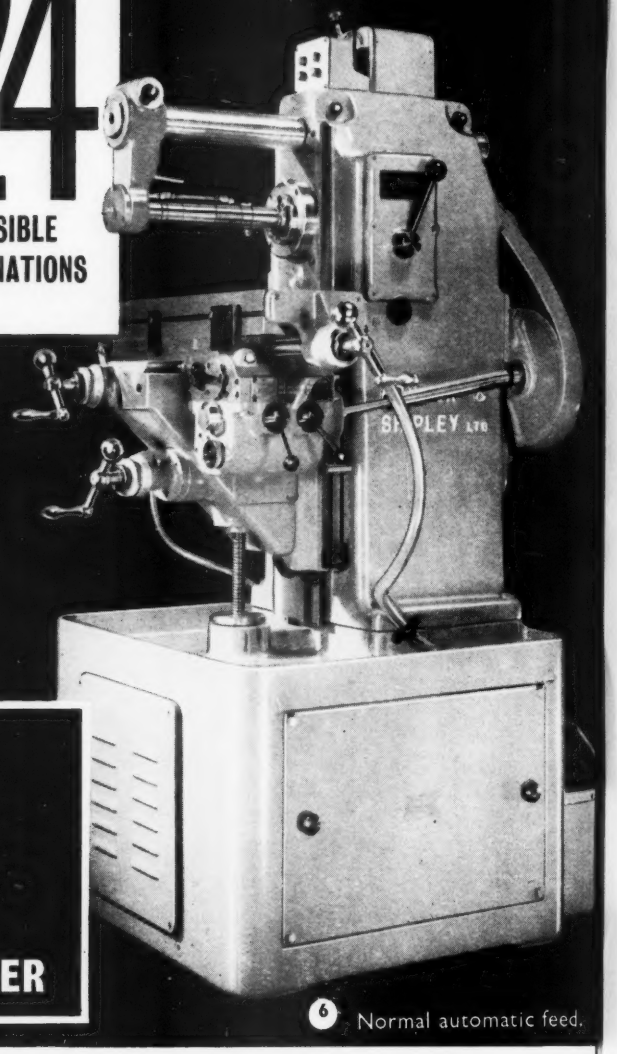
6 x 4 = 24

TYPES OF FEED | SPEED RANGES | POSSIBLE COMBINATIONS

that's the beauty of the

A&S

MODEL 'I' HORIZONTAL MILLER



6 Normal automatic feed.

WHY PAY FOR 'SPECIAL' FEATURES YOU MAY NEVER USE?

When you equip with A & S Model '1' Millers you choose from 4 ranges of speeds and 6 different feed arrangements the best combination* for a particular job. Both hand-feed and automatic types can however be supplied with special attachments for special operations. No other small milling machine offers similar versatility or higher production capacity for so wide a range of work.

TABLE 26" × 7"
LONGITUDINAL TRAVERSE = 10"
VERTICAL TRAVERSE = 10"
TRANSVERSE TRAVERSE = 5½"–6"

**With the A & S Model '1' brochure in front of you, you would know exactly what we mean.*

Built up to a standard-not down to a price

Write for illustrated leaflet

ADCOCK & SHIPLEY LTD

P.O. Box 22, Ash Street, Leicester. Telephone : Leicester 24154-6. Telegrams & Cables : Adcock, Leicester.

"The man who designed these starters knows our problems"

"Very compact for 100 H.P." *"All front wired"*

"Excellent mechanical interlock" *"We could save space with these"*

"Similar design from smallest to largest" *"Extra auxiliary switches easily added"*

"We'd better change to Square D"

Class 8736 A.C. Reversing Magnetic Starters

FIELD OFFICES—LONDON · BIRMINGHAM · MANCHESTER & GLASGOW

SQUARE D LIMITED

100 ALDERSGATE STREET, LONDON, E.C.1 Telephone: METropolitan 8646

SD19

Foreshadowing long runs in die casting . . .

Here are some steels which we can confidently recommend to overcome your die problems.

Edgar Allen AM3 Die Steel is a steel with molybdenum, chromium and a high vanadium content which gives great resistance to heat checking and erosion of die-casting dies and other hot-work tools.

Edgar Allen AM1 Die Steel combines toughness and resistance to abrasion and heat checking, comparing favourably with some of the more expensive high-tungsten steels.

Other Edgar Allen Die Casting Die Steels are "Maxinium," suitable for use with the higher melting point alloys, and "Lominium," primarily developed for zinc base alloys, but suitable also for other work. Write for full particulars of our range of Die Casting Die Steels.

AM1 & AM3 STEELS

for Die Casting Dies

Edgar Allen & Co. Limited
IMPERIAL STEEL WORKS · SHEFFIELD · 9

For this Booklet post the coupon to-day

To EDGAR ALLEN & CO. LTD. IPE/TS23
SHEFFIELD 9

Please post details on Die Casting Die Steels to:

Name .....
Position .....
Firm .....
Address .....

Investigate . . .
. . . the enormous advantages of the Dedlock System, which completely replaces expensive Shell End Mills, Face Mills, Large Taper Shank End Mills and Cylindrical Cutters. Dedlock gives double capacity and real accuracy with maximum feeds and speeds; it requires only one arbor to take the whole range of cutters, from 2" to 8". With Dedlock, the heavier the cut, the tighter the grip.
CLARKSON
Dedlock
101
For full details of this wonderful system SEND COUPON TODAY

Clarkson
(ENGINEERS) LTD.
Nuneaton · Warwickshire
And at: Belfast · Birmingham · Bristol · Glasgow Leeds · London · Manchester · Newcastle

Please send me full details of the Clarkson Dedlock System

Company .....

Address .....

.....

Name of Executive enquiring .....

ournal of Institution of Prod. Engrs.

This... ...is a line we're not shooting!

New, dramatically improved Mobil DTE Oils give a *balanced* protection and service performance *that no other oil on the market today can equal.*

New Mobil DTE Oils for hydraulic and circulating systems have many specific advantages which, taken together, make a convincing reason for preferring them to any other oils of their kind. Here are some of the advantages you will get if you use new Mobil DTE Oils:

LONGER OIL LIFE ✓
STABILITY AT ALL TEMPERATURES ✓
FREEDOM FROM DEPOSITS ✓
PROTECTION AGAINST RUST AND CORROSION ✓
QUICK SEPARATION FROM WATER ✓
LESS WEAR ✓

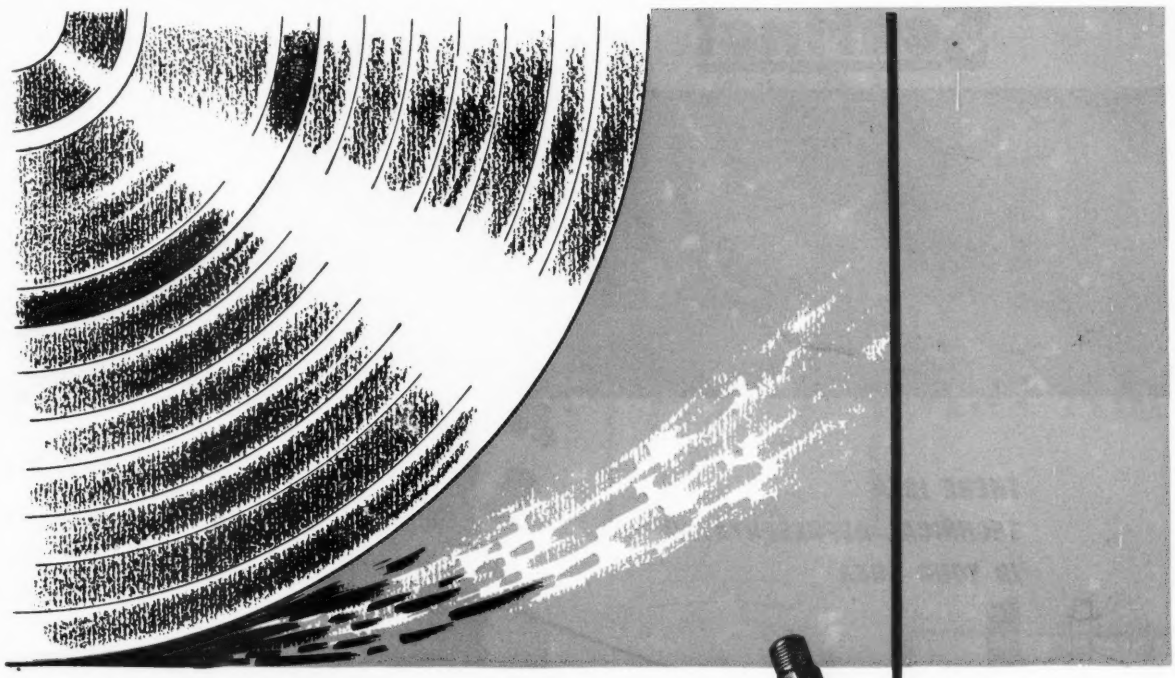
NEW balanced Mobil DTE Oils for protection and performance no other oil can equal

ASK THE MAN FROM MOBIL

This line is no exaggeration. It is the plain truth, proved in careful tests against other well known hydraulic and circulating oils. The line down our left-hand margin is taken from a chart of these tests. Ask your Mobil representative to show you the chart. He will explain how, on *balance*—on the results of all the tests—new Mobil DTE Oils show a clear advantage that can mean lower costs and improved production in your business.

Mobil

MOBIL OIL COMPANY LIMITED, LONDON S.W.1



Smooth-running ROTOGRIND gives extra high power/weight ratio —Holman Series 30 Pneumatic Grinder

In free speed, the Rotogrind gives you 8,000 r.p.m. at 80 lb./sq. in. Yet it weighs only 7½ lb. without the wheel. And you can use really *fast-cutting* wheels because the Rotogrind has a specially smooth-running high-speed motor.

Fast, smooth working, easy handling—all this the Rotogrind gives you—and one more thing: low running cost. It's running cost, remember, that's the real cost of pneumatic tools. It's the running cost and the breakdowns you *don't* suffer that make the Rotogrind worth more than its price.

Look carefully then, at the Rotogrind. Note its simplicity . . . the hard chrome plate on parts which take heavy wear . . . the spindle carried by three ball bearings—themselves sealed off from live and exhaust air. Note the automatic lubrication and the exclusive Holman way of controlling blade pressures on the cylinders—minimising friction, increasing torque, *reducing wear.*

Look carefully at the Rotogrind and admit that you couldn't make a wiser choice.

Holman PNEUMATIC EQUIPMENT

pays... with its life

HOLMAN BROS. LTD., CAMBORNE, ENGLAND

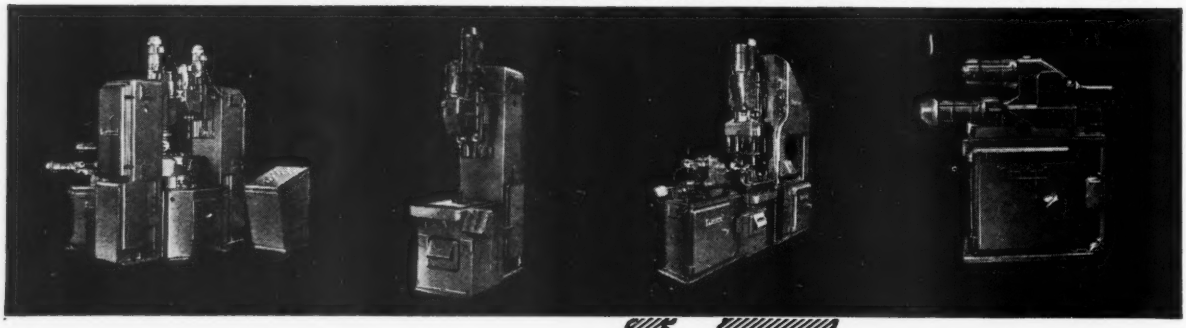
The Holman Organisation is world-wide. It includes the Climax Rock Drill & Engineering Works Ltd., and has agents, branches and technical representatives throughout the United Kingdom and in 84 other countries.

Telephone: Camborne 2275 (10 lines). Telegrams: Airdrill, Telex, Camborne. London Office: 44 Brook Street, W.1 Telephone: Hyde Park 9444

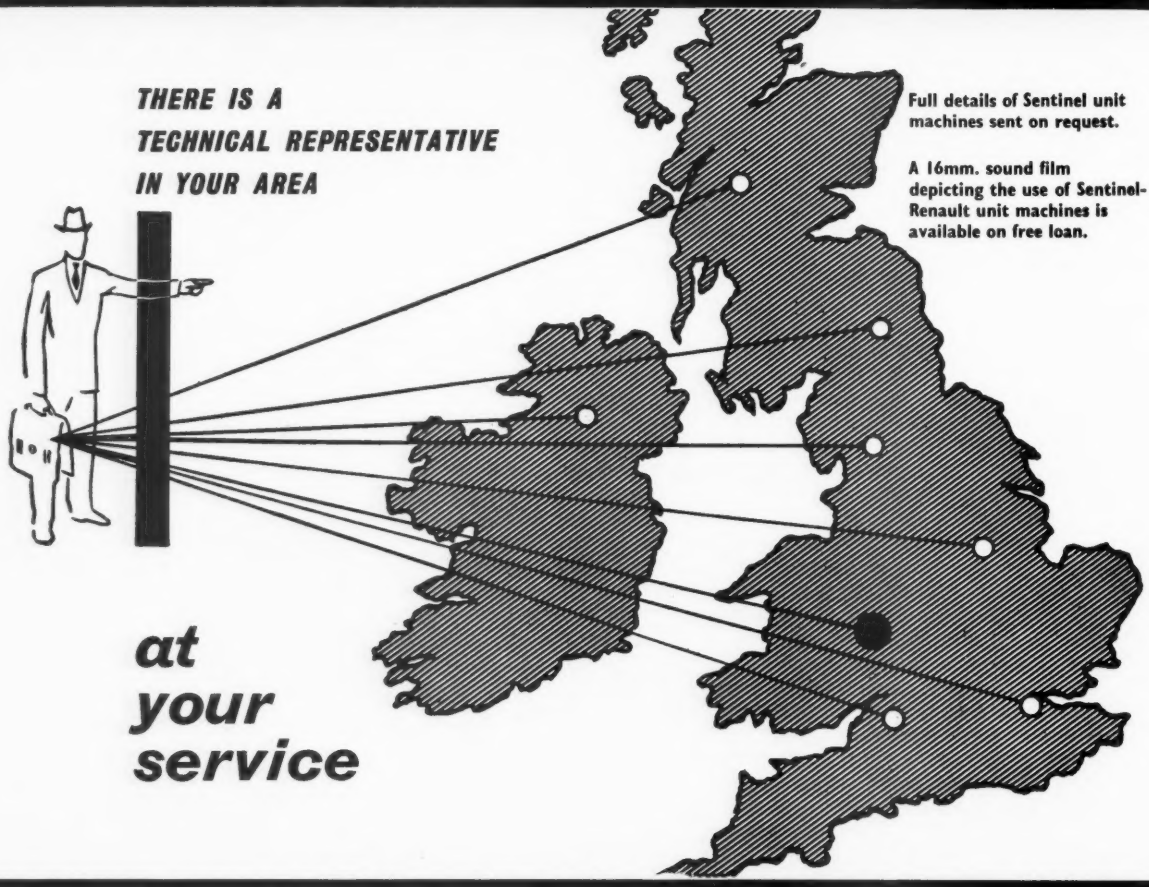
HJ20

Sentinel unit machines

INCORPORATING THE RENAULT FRANCE SYSTEM ELECTROMECHANICAL HEADS



THERE IS A TECHNICAL REPRESENTATIVE IN YOUR AREA



Full details of Sentinel unit machines sent on request.

A 16mm. sound film depicting the use of Sentinel-Renault unit machines is available on free loan.

at your service

Sentinel adaptability—versatility—flexibility

Sentinel Unit Machines are built up from standard bases (with enclosed switchgear) and rotary tables, all of which have machined mating faces for assembly into varied combinations of units.

Vertical Column 7-8-9 ft | 3 ft. Wet Base | 3ft. Dry Base | 5 ft. Dry Base | 5 ft. Wet Base | 3-way Centre Table | 4-way Centre Table | Bridge Column on 4 ft. Dry Base

SENTINEL (SHREWSBURY) LTD SHREWSBURY ENGLAND

Telephone: SHREWSBURY 2011 Telegrams: "SENTNOLL SHREWSBURY" London Office: 15 Conduit Street LONDON W.1 Telephone: MAYFAIR 2675

P.4186

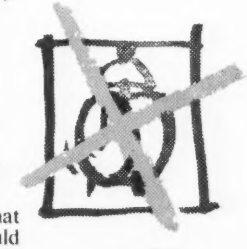
One of our more demanding customers thought he'd given us a stumer the other day. "Give me" he said, "a system of automatic control that not only produces the goods faster than ever before, but which I can personally add to and take away from at will." Quick as a flash Max Am arrived on cue. "Done!" he cried and in no time at all the necessary bits and pieces together with a plan of engaging simplicity, appeared in the customer's works.

Do-him-yourself . . . Max Am

If you will cast your mind back to those glorious days of your youth, when you spent hour after happy hour constructing fascinating microcosms of engineering with perforated steel strips, then you will grasp the principle (though not necessarily the simplicity) of Max Am. For one of the advantages of Max Am is that you can do-him-yourself. All the bits and pieces, together with a plan and full instructions, can be delivered to you for any process or sequence you care to mention.

There are other, greater, advantages. Productivity is boosted (up to 600% according to some of our customers). Maintenance and operating costs nearly do the disappearing act altogether, for maintenance is trifling, and of operating there is practically none.

But enough of this boasting! If you feel that the unobtrusive presence of Max Am would be beneficial in your works, we shall be very glad to confirm your sound judgement.



MAXAM

Nothing could be simpler

This is a double-solenoid, 2-position, 5-connection valve, pressure-operated both ways. There are more than 100 other valves — pilot, solenoid, hand or pressure operated. All Maxam valves combine with mechanical, electrical, hydraulic or other controls to form integrated systems.

Valves, Cylinders and Airline Equipment

THE CLIMAX ROCK DRILL AND ENGINEERING WORKS LIMITED

Carn Brea, Redruth, Cornwall
Telephone Camborne 2261

4 Broad Street Place, London E.C.2
Telephone London Wall 5111

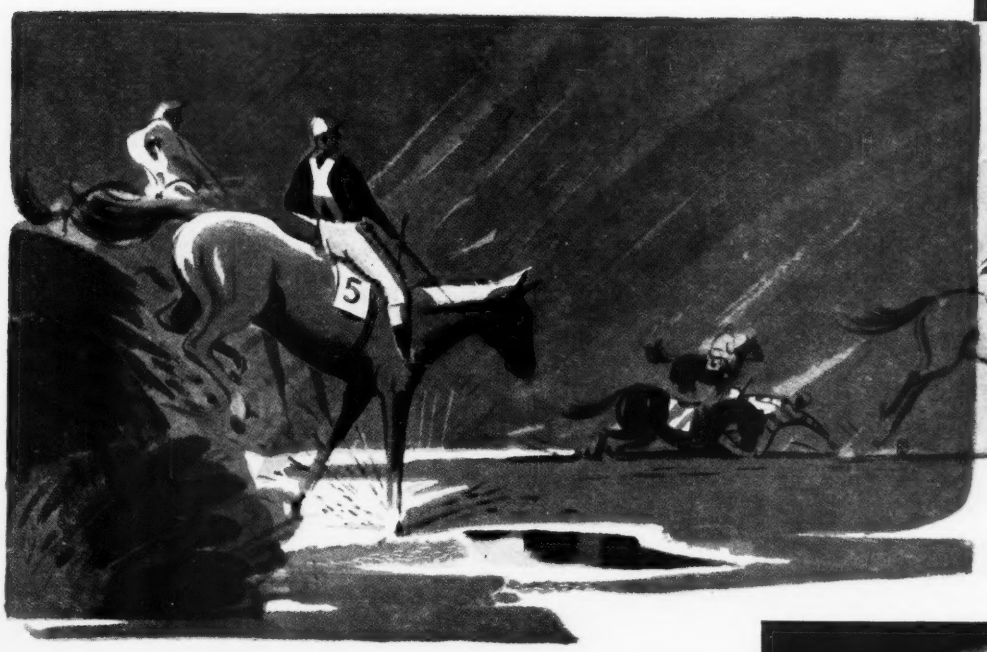
One of the companies of the world-wide Holman Organisation, which has agents, branches and technical representatives throughout the U.K. and in 84 other countries.

RACK mechanical pallet trucks

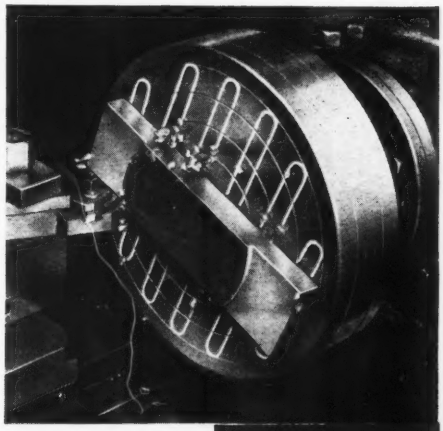
- All welded steel construction, lightweight design
- Steel Ball-bearing wheels
- 1000 lb. capacity
- Immediate delivery from stock

WRITE FOR BULLETIN TODAY RACK ENGINEERING LIMITED
MONTROSE AVENUE, SLOUGH

When the going's tough . . . . . .



. . . . when, for example, you are making heavy, interrupted cuts on hard steel . . . . that's when "Eclipse" tool bits prove themselves. Quality of steel? . . . modern plant? . . . care in manufacture? . . . undoubtedly they're important. But it's the general "know how" about tool bits and what they should do that has put more "Eclipse" tool bits into more tool holders. Incidentally, have you seen the new "Eclipse" tool holders? Take a look at the patented clamp which, by exerting downwards and sideways pressure, clamps the tool bit rigidly and ensures that it cannot possibly move. Here again, it's knowing what is wanted that has provided another well-designed addition to the "Eclipse" range.



Eclipse **tool bits**

MADE FROM H-3 COBALT HIGH SPEED STEEL

Made by James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors

UT 6

Her inventive genius is Britain's great capital asset. Other nations are richer in material resources, but this country has never failed to lead scientific progress. So we remain in the forefront of a nuclear-electronic age.

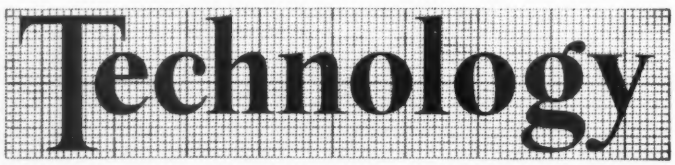
How long will this continue ? Our productive enterprises can only flourish if the training of technologists, technicians and apprentices is correlated to the needs of industry. Those who train and those who employ must work together.

To ensure the fullest possible discussion between industry and educationists, *The Times* publishes TECHNOLOGY.

This monthly review of training and education for industry reaches the training and planning staffs of modern industry as well as lecturers and teachers at universities, technical colleges, public, grammar and secondary modern schools.

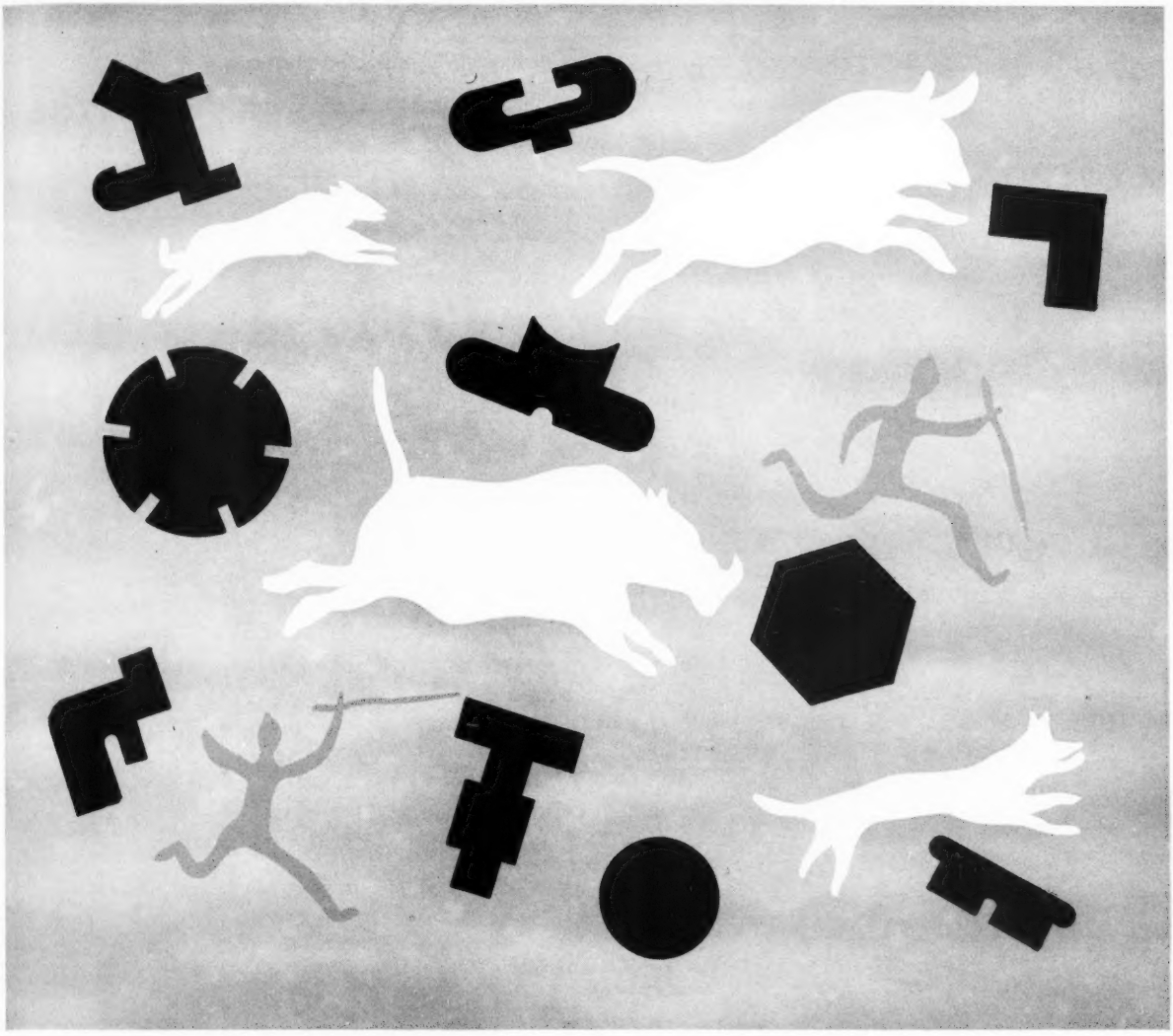
TECHNOLOGY has a vital interest in the work of the Colleges of Applied Technology. TECHNOLOGY attends to the problems of apprenticeship. Each month a general article deals with a particular aspect of technological advance.

If you employ technologists, technicians and apprentices, if you are concerned in their training, you *need* TECHNOLOGY to-day. Tell your newsagent you must have TECHNOLOGY each month.



MONTHLY—PRICE ONE SHILLING

Your newsagent will be pleased to order TECHNOLOGY *for you or a direct annual postal subscription* (18*s. inland;* 16*s.* 6*d. abroad*) *may be arranged through the Subscription Manager,* TECHNOLOGY, *Printing House Square, London, E.C.4.*



discoveries of the Bronze Age

. . . . That there is a PARSONS, IMMADIUM OR CROTORITE BRONZE specification to meet pretty well every demand in modern engineering.

. . . . that the consistent quality of these metals make them highly efficient in resisting high temperatures, corrosion and shock.

. . . . Manganese Bronze and Brass continue to make many discoveries which produce alloys of undoubted efficiency.

IN EXTRUDED RODS, BARS, TUBES AND SECTIONS, AND FORGINGS
ROLLED SHEETS AND PLATES.

PARSONS
MANGANESE BRONZE

IMMADIUM
HIGH TENSILE BRONZE

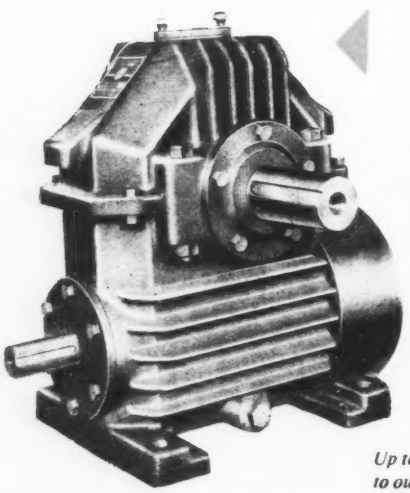
CROTORITE
ALUMINIUM BRONZE

THE MANGANESE BRONZE AND BRASS COMPANY LIMITED

HANDFORD WORKS HADLEIGH ROAD IPSWICH · TELEGRAMS BRONZE IPSWICH · TELEPHONE IPSWICH 2127

295

Off the shelf for IMMEDIATE DELIVERY!



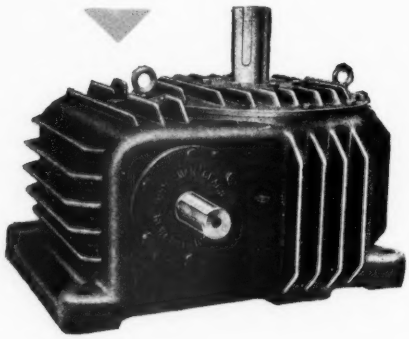
Type SUH

Worm Geared Unit with horizontal output shaft.
$2\frac{1}{2}$" to 9" centres.
Standard ratios **5 – 1** to **60 – 1.**

Type SV

Worm Geared Unit with vertical output shaft.
$2\frac{1}{2}$" to 9" centres.
Standard ratios **5 – 1** to 60 – 1.

Up to 70 H.P. according to output speed.



LARGER UNITS

and double reduction gears
ratios up to 3000 – 1

ON SHORT DELIVERY

OPPERMANS OF NEWBURY

OPPERMAN GEARS LTD, NEWBURY, BERKSHIRE · Tel: Newbury 1701 · Grams: Oppigears, Newbury

In the production of these insulated shrouds and for potting transformers, South Wales Switchgear Ltd. use 'Araldite' casting resins. For every branch of electrical engineering, 'Araldite' offers advantages which make it invaluable. These include remarkable adhesion to metals and ceramics, excellent electrical properties, stability and resistance to moisture. The two units illustrated are an insulated shroud for a 33kV switchgear earthing device and a 3-phase voltage transformer, ratio 6600/110V, 200VA.

Earth... and potting

'Araldite' epoxy resins have a remarkable range of characteristics and uses:

They are used

- **for bonding metals, porcelain, glass, etc.**
- **for casting high grade solid insulation**
- **for impregnating, potting or sealing electrical windings and components**
- **for producing glass fibre laminates**
- **for producing patterns, models, jigs and tools**
- **as fillers for sheet metal work**
- **as protective coatings for metal, wood and ceramic surfaces**

'Araldite' *epoxy resins*

'Araldite' is a registered trade name

Aero Research Limited *A Ciba Company. Duxford, Cambridge. Tel: Sawston 2121*

AP.264-233

xxii

PNEUTOMATION

Registered Trade Mark

at work

This tube saw with hydro-pneumatic feed is evidence of how Pneutomation has been put to work at Messrs. Murray and Watson, Dudley. For automatic control, consistent quality and lower costs Pneutomation is the simple answer.

LANG PNEUMATIC CONTROL GEAR

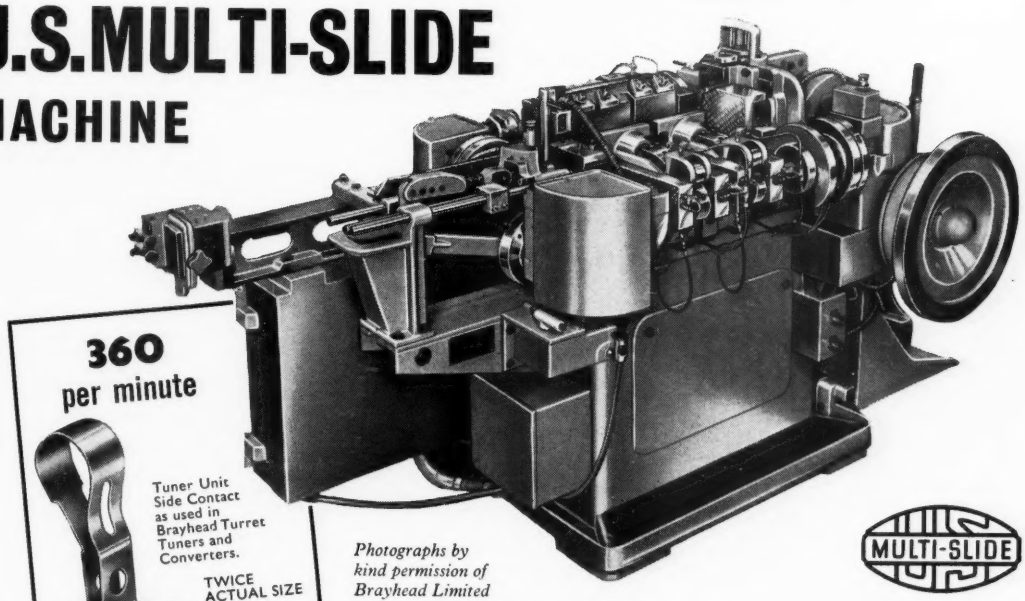
entirely non-corrodible

Plan with **LANG PNEUMATIC LTD**

VICTORY WORKS BIRMINGHAM ROAD WOLVERHAMPTON Tel: 25221-2-3

360 COMPLETE COMPONENTS per minute

with the New British-Built U.S.MULTI-SLIDE MACHINE



Photographs by kind permission of Brayhead Limited

The British built 'U.S.' Multi-Slide is an automatic machine designed for the economical production of stampings from coil stock. The various motions provided by the die head (ram), forming slides, vertical stripper mechanism and a range of auxiliary units afford the die designer practically unlimited possibilities for the development of tools to produce stampings at considerably lower piece part cost by eliminating secondary operations and handlings.

The flow of power is smooth as operations are so timed that the load is distributed throughout the cycle. This reduces wear and greatly extends the life of the machine and tools.

The two sizes of British built U.S. Multi-Slide machines (built for us by Alltools Ltd) are now available and can be supplied completely tooled for one or more components; the tool design being based on the vast experience accumulated by the U.S. Tool Co. Inc.

Send for illustrated leaflets, also ask to see film showing operation of the machine and examples of components produced. Our Sales Engineer will be pleased to call on request.

Brief Specifications

Machine Model	28	35
Length of Feed	8″	12½″
Maximum Width of Stock	1½″	3″
Maximum Thickness of Stock	1/16″	3/32″

ROCKWELL
MACHINE TOOL CO. LTD.

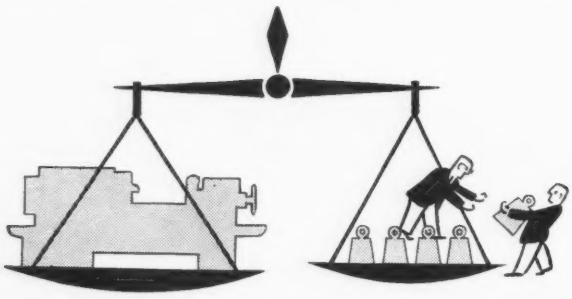
For further particulars write or telephone TODAY

WELSH HARP, EDGWARE RD., LONDON, N.W.2.
TEL: GLADSTONE 0033

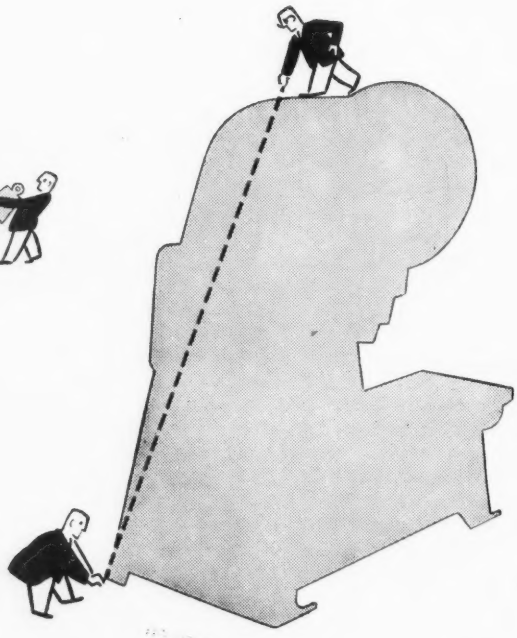
ALSO AT BIRMINGHAM – TEL: SPRINGFIELD 1134/5 • STOCKPORT – TEL: STOCKPORT 5241 • GLASGOW – TEL: MERRYLEE 2822

U.S.4

HOW DO YOU BUY MACHINE TOOLS?



BY WEIGHT?



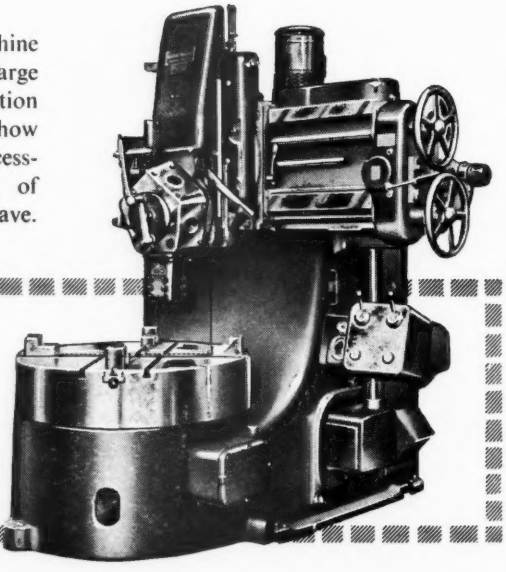
BY VOLUME?

OR BY HONEST-TO-GOODNESS FITNESS FOR PURPOSE?

Whichever method you favour you'll find there is no better value in the world, to-day, than Webster and Bennett Boring Mills.

Because the range is restricted to variations of a single basic type, production resources are rationalised, resulting in low manufacturing costs and therefore low prices.

You can find evidence of their popularity in most machine shops concerned with the boring and turning of medium to large castings and forgings, and if you *can* conduct a short investigation on your own account, ask how long they have used them; how they like the centralised hydraulic control system; or the accessibility of the unit-constructed sub-assemblies and ease of servicing. You'll get the answers we would like you to have.



This is a standard Webster and Bennett Boring and Turning Mill with 48″ dia. chuck, admitting jobs of 53″ dia., with 35″ under the turret and 24″ under the cross-slide.
Machines can be supplied with Screwcutting, Taper Turning, or Spherical Turning Attachments, or with built-in Electronic Profile Turning Equipment.

WEBSTER & BENNETT LTD., COVENTRY, ENGLAND

Photograph by courtesy of Briggs Motor Bodies Ltd.

'Fescol'-ised Air Cylinders help to keep Production Moving

The air cylinders supplied by Baldwin Instrument Co. Ltd., to provide power operation for automatic work handling devices, have 'Fescol'-ised bores and piston rods to reduce friction and ensure maximum life from seals. This is one further example of the way in which Fescol, who pioneered the electro-deposition of nickel and chrome for engineering purposes, still lead the way, adapting their process to help each new industrial development.

If you would like to know more about the process, and its use in preventing corrosion and protecting new machinery please send for publication No. PE6.

FESCOL

Established 1920

FESCOL LIMITED · NORTH ROAD · LONDON N 7

BRANCH WORKS AT PORT GLASGOW, HUDDERSFIELD AND BROWNHILLS

Sole Licensees for Australasia: De Havilland Aircraft Pty. Ltd., Milperra Road Bankstown, N.S.W

Don't waste these skilled hands...

Ensure continuously accurate inspection with SIP Measuring Machines

Though the experienced inspector makes determined efforts to ensure precise control of dimensions, he is constantly hampered by inaccurate measuring devices. Precision gauge blocks are subject, however imperceptibly, to wear. They are unable to guarantee the close tolerances essential for interchangeability of parts.

SIP Measuring Machines take this costly source of error and waste out of the inspector's hands. They provide a wear-proof master against which the dimensions of all inspection gauges can be checked. The need for inspection gauges is eliminated over short runs. A system of finely adjusted microscopes enables the measurements to be quickly and easily taken, thereby speeding the inspection of machined parts.

The unexcelled standard of accuracy achieved with SIP Measuring Machines is derived from a Standard Scale calibrated by the most advanced photo-electric techniques.* The Scale is embodied in each machine and freed from contact with moving parts. Its lasting precision gives a degree of measuring accuracy never before possible.

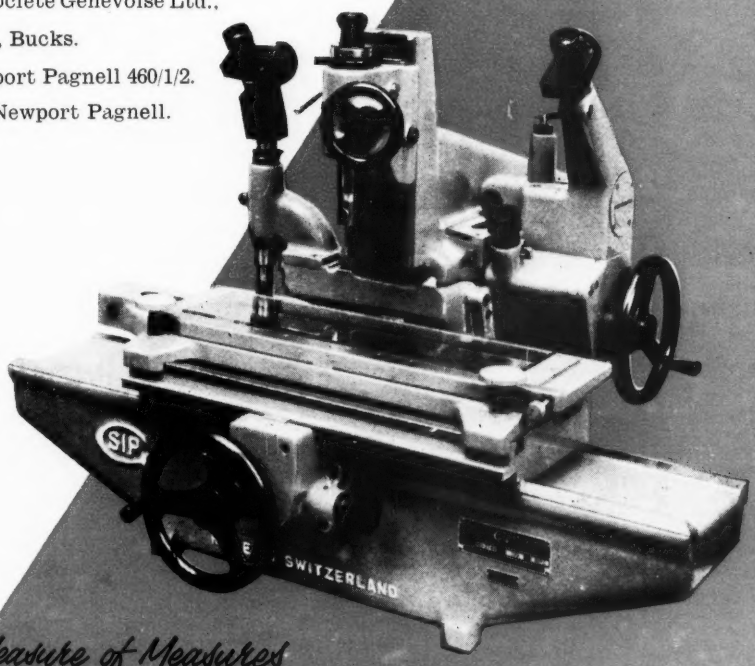
Measuring Machines by

The Universal Measuring Machine

Type MU-214B

Measurements in *three rectangular co-ordinates* enable workpieces of all types to be checked including internal and external thread gauges.
The large T-slotted table accommodates workpieces of any weight within the dimensional capacity of the machine.
A wide range of accessories enables the machine to be adapted to many other requirements of the user.
The MU-214B is one of several Measuring Machines in the manufacturing programme of Société Genevoise d'Instruments de Physique which also includes:
MUL-1000, MUL-3000 and MUL-4000 Universal Measuring Machines of 1, 3 and 4 metre linear capacity.
MUL-250 Shop Gauge Measuring Machine.
Detailed information about SIP Measuring Machines is available from Société Genevoise Ltd., Newport Pagnell, Bucks.
Telephone: Newport Pagnell 460/1/2.
Telegrams: SIP Newport Pagnell.

Guaranteed measuring accuracy:
up to 4″ 0.00005″ max. error
up to 8″ 0.00006″ ,, ,,
up to 16″ 0.00008″ ,, ,,



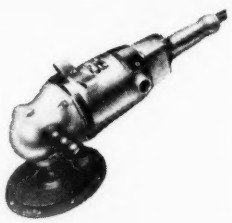
*The Standard Scale is graduated on the same machine and with the same great precision as the fundamental length prototypes supplied by SIP to the National Physical Laboratory (Teddington), the International Office of Weights and Measures (Sèvres) and the National Bureau of Standards (Washington).

SIP *the Measure of Measures*

BLACK & DECKER – THE TOOLS FOR EVERY INDUSTRY

7″ SANDER-GRINDER

A heavy duty model, invaluable for continuous production work. Easy to handle, with immense power. Makes light work of metal cleaning, de-rusting, tool-sharpening, grinding, etc.

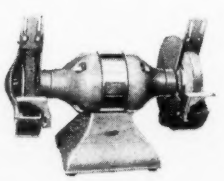


¼″ H. D. HOLGUN

One of 16 drills available, ranging from ⅛″ H. D. Holgun to 1½″ H. D. Drill. Ideal for construction, assembly, maintenance and repair work in any material from wood to steel.

10″ BENCH GRINDER

6″, 7″ and 8″ models also available. Powered by constant speed motors and adaptable for buffing, wire wheel brushing, grinding and tool sharpening. Pedestal mountings can be supplied.



Other tools in the range include Saws, Orbital Sanders, Shears, Screwdrivers, Valve Refacers, Valve Seat Grinders and Hammers.

WE CAN SHOW YOU HOW

A demonstration without obligation, under your own site conditions will convince you that Black & Decker tools can effect tremendous savings in time and labour in your business.

Send coupon, or telephone to

BLACK & DECKER LTD., HARMONDSWORTH, MIDDLESEX · ***West Drayton 2681/9***

—or your nearest branch

Birmingham	Crompton Road, Long Acre, Birmingham 7. Phone: East 3411/2.
Bristol	29 Broad Street, Bristol 1. Phone: Bristol 25781.
Glasgow	126 North Street, Glasgow, C.3. Phone: Glasgow City 7195.
Leeds	13 Greek Street, Leeds. Phone: Leeds 34361.
London	378/380 Holloway Road, London, N.7. Phone: North 3256.
Manchester	Knott Mill, Manchester, 15. Phone: Blackfriars 8865.
Nottingham	27/31 Wollaton Street, Nottingham. Phone: Nottingham 47333.
Newcastle	126/128 Heaton Road, Newcastle. Phone: Newcastle 655710 and 656700.

NAME .....

ADDRESS .....

.....

.....

BUSINESS .....

I am interested in a demonstration of the following tool(s).....

No. 1038

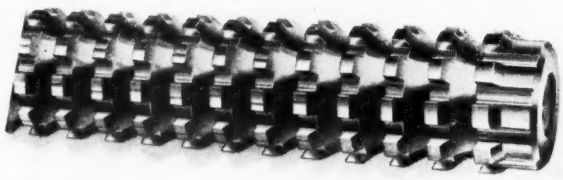
USERS TECHNICAL ADVISORY SERVICE

For free advice and assistance on the operation and application of Electric Tools, write to the Users Advisory Service, Black & Decker Ltd., Harmondsworth, Middlesex.

Black & Decker

ELECTRIC TOOLS

Smee's I.A. 15



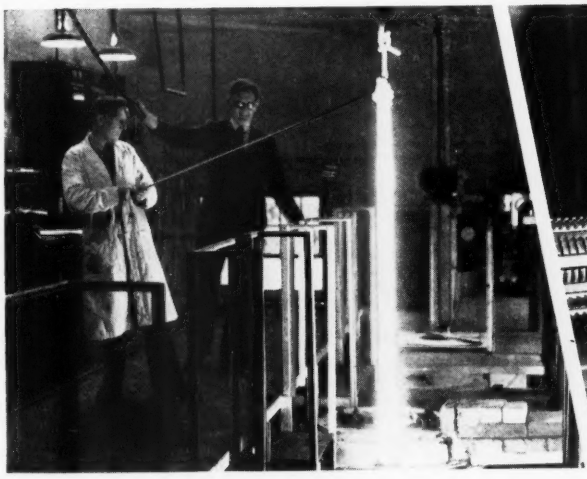
BROACHES?

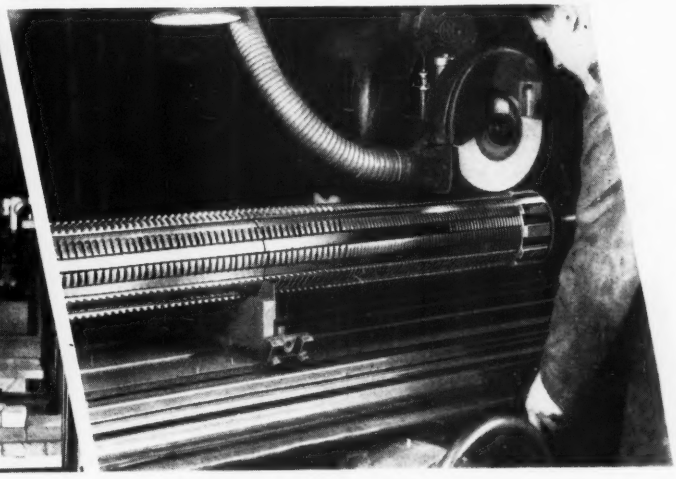
a complete service

B·S·A

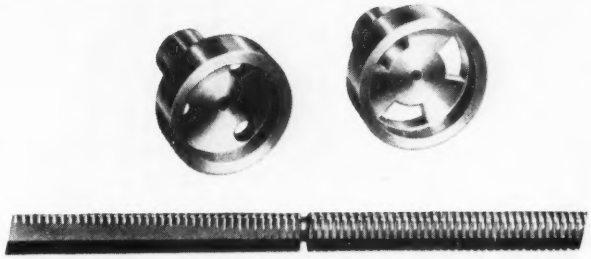
BROACH DIVISION

- DESIGN
- MANUFACTURE
- APPLICATION
- MAINTENANCE





The Broach Division of B.S.A.Tools Limited is the largest plant in Europe devoted to broach production and broaching technique. It has the capacity to design and manufacture every type of broach (from those of needle size for machining metering jets to examples weighing half-a-ton or more) and is equipped for broach function-testing and for demonstrating how broaching can effect economies compared with other methods of machining. Others of its services are the regrinding of broaches and the evolving of special equipment for adapting existing machines to new broaching requirements. In fact, the B.S.A. Broach Division offers a complete service to broach users and to those contemplating the application of broaching.



TRADE MARKS

B·S·A TOOLS GROUP

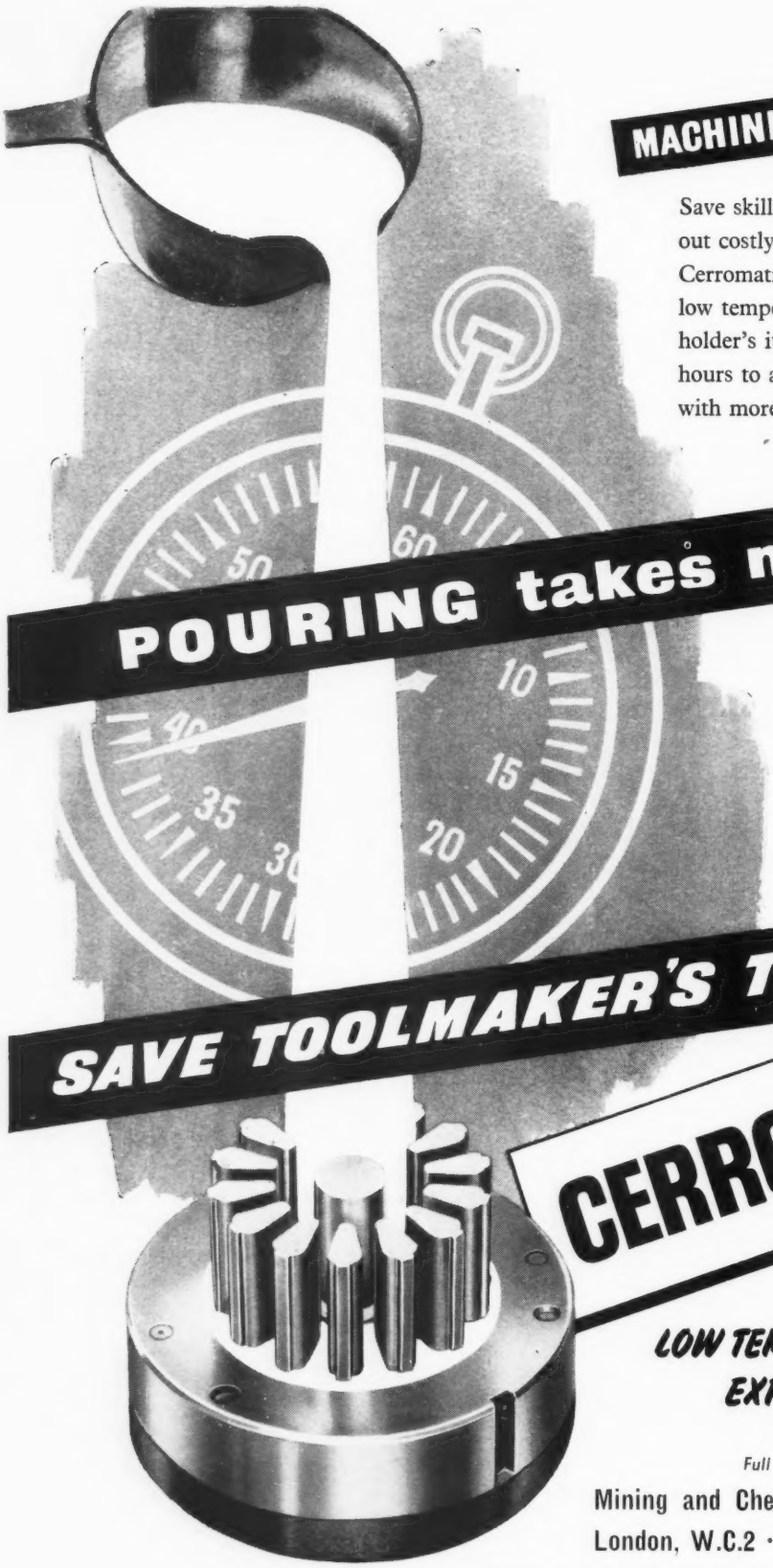
Until broaching was applied to machine the "dovetail windows" in this component the floor-to-floor time was 45 minutes. By broaching with a set of three B.S.A. broaches the time was reduced to 4½ minutes! A brochure giving further examples is available on request.

B.S.A. TOOLS LIMITED

BROACH DIVN., REDDITCH, WORCS.

Sole Agents in Great Britain

BURTON GRIFFITHS & CO. LTD., Broach Division, STUDLEY ROAD, REDDITCH, WORCS. Telephone: REDDITCH 1291



MACHINING TAKES HOURS

Save skilled toolmaker's time and cut out costly machining by using Cerromatrix. By simply pouring the low temperature-melting alloy into punch holder's it takes minutes instead of hours to anchor the punches compared with more orthodox methods.

POURING takes minutes

SAVE TOOLMAKER'S TIME with CERROMATRIX

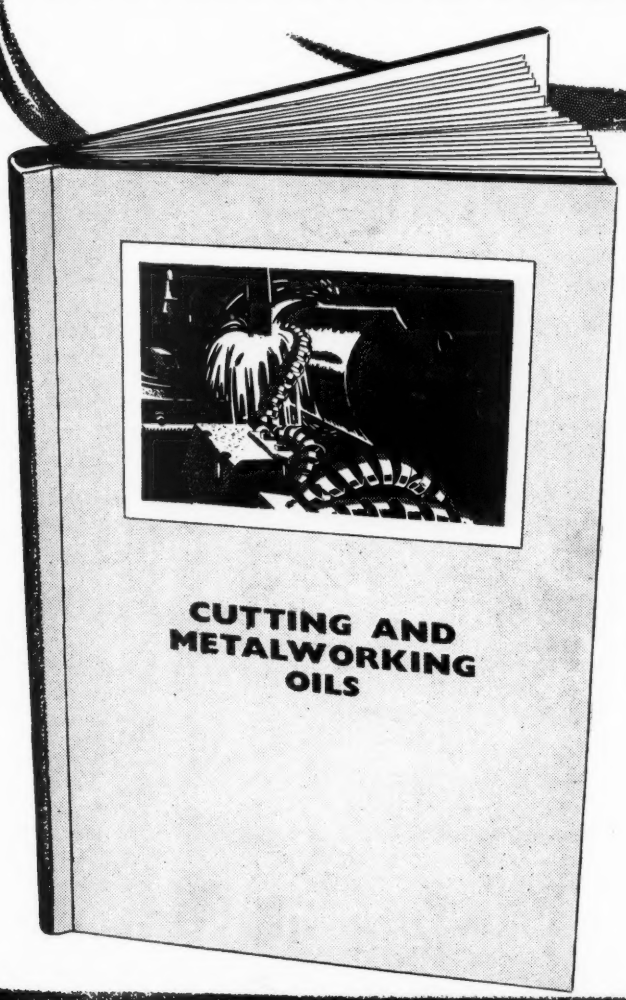
LOW TEMPERATURE-MELTING EXPANDING ALLOY

Full Technical details on request

Mining and Chemical Products Ltd · 86 Strand London, W.C.2 · Telephone: Covent Garden 3393

70-76 Alcester Road South · Kings Heath · Birmingham 14 · Telephone: Highbury 2281

AVAILABLE NOW!
– to all users of
CUTTING and METALWORKING OILS



If your company uses metalworking coolants and lubricants we should like you to have a complimentary copy of our new publication, "Cutting & Metalworking Oils." Simply send us the coupon below and your copy will be on its way to you by return of post.

INDUSTRIAL
WAKEFIELD-DICK
LUBRICANTS

COUPON | *Please send me a complimentary copy of "CUTTING & METALWORKING OILS"*

NAME OF COMPANY.....

ADDRESS.....

.....

FOR THE ATTENTION OF.....

Post this coupon to Dept. P.D., Wakefield-Dick Industrial Oils Ltd., 67 Grosvenor Street, London, W.1. I.P.E.

A TI Company

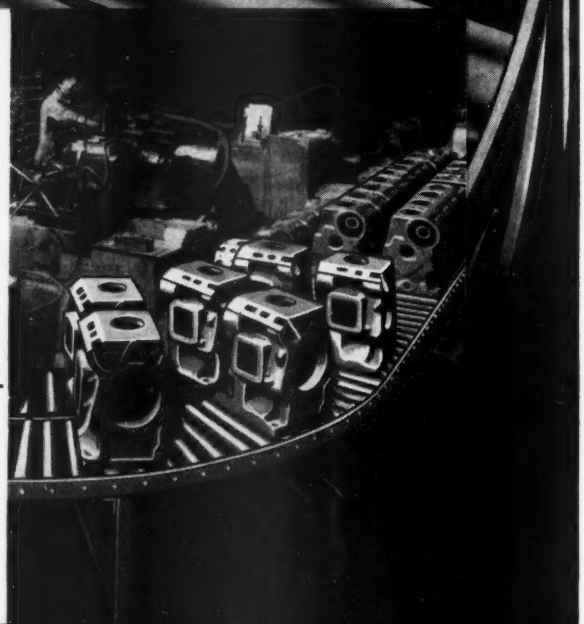
NEWCON

roller conveyors

the most economical answer to most handling problems

For light or heavy loads Newcon Conveyors are the simplest, cheapest and most adaptable method of mechanised movement. Using gravity to provide momentum, a continuous movement of goods can be maintained between processes, giving a fine control of speed according to the inclination of the conveyor.

Newcon rollers are made in a range of standard, heavy duty, extra duty and moisture proof types. Track is supplied normally in 8′ and 10′ sections; curved sections and branch lines are also available as standard.



Please send literature and full details (Please tick those req.)
ROLLER CONVEYORS ☐ IDLERS ☐ DRUMS ☐

NAME_____

FIRM_____

ADDRESS_____

NEW CONVEYOR CO LTD

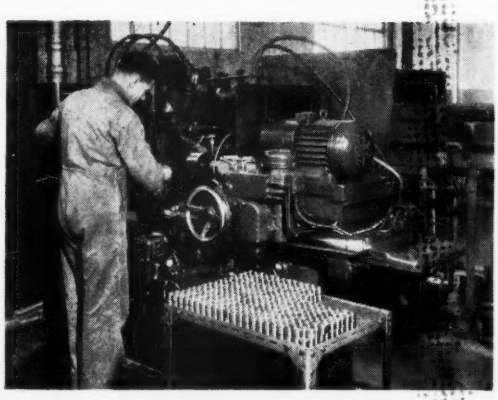
HEAD OFFICE: SMETHWICK BIRMINGHAM 40 ALSO AT LONDON MANCHESTER GLASGOW

P2870

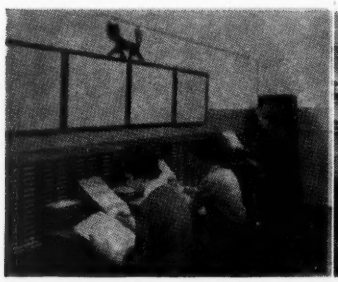
B·A·C

DRILL BUSHES

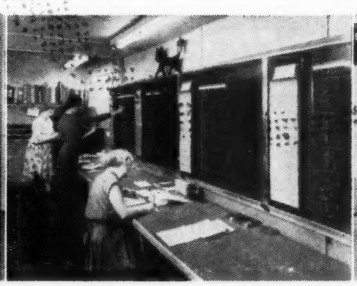
the best bushes — and the set-up that gives the best service



PRODUCTION



ORDERING



PROGRESSING

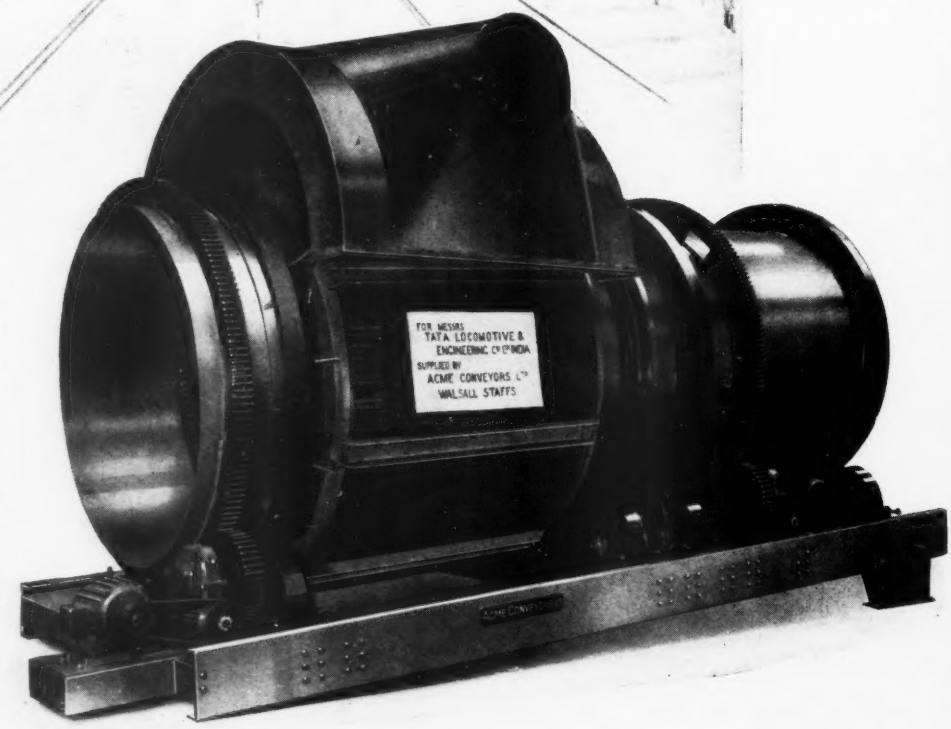
Over 23,000 sizes available — and this figure does not include all the Continental and American standards in regular production. The B.A.C. range is un-matched for scope or availability, pointing to one clear conclusion — ***the best bush maker gives the best bush service.***

B·A·C
The Bush with 9 Lives

BRITISH AERO COMPONENTS LTD.
MONTAGUE ROAD, WARWICK TELEPHONE WARWICK 320.

Cogent

DRUMS IN INDIA



This Breaker-Cooler and Screening Drum was designed and manufactured by Acme Conveyors Ltd. for the Tata Locomotive and Engineering Co. Ltd., India.

Having a length of 22 feet and an approx. diameter of 8 feet, it is capable of handling up to 100 tons of foundry sand per hour. It forms only part of a complete mechanised plant supplied to Tata.

ACME CONVEYORS LTD. are widely experienced in the design and installation of such plants and would welcome the opportunity of assisting you with your mechanical handling problem, whatever the field. A card or telephone call will bring you literature or a visit from our representative whichever suits you best. Please refer to Dept. DI.

ACME CONVEYORS LIMITED

ACME CHAMBERS · BRADFORD ST. · WALSALL · STAFFORDSHIRE

Telephone: Walsall 5183/4 & 6793 *Telegrams:* Acknight, Walsall

WORKS ALSO AT CARLYLE AVENUE, AND HILLINGTON ROAD, HILLINGTON, GLASGOW

today's
cutting tools
are
Cutanit
CEMENTED CARBIDE
WM JESSOP & SONS LTD
BRIGHTSIDE WORKS SHEFFIELD
J J SAVILLE & CO LTD
TRIUMPH WORKS SHEFFIELD
ALL ENQUIRIES TO: SMALL TOOL WORKS PORTLAND ST SHEFFIELD 6 TELE 20224

CROFTS VARIABLE SPEED MOTOR GEARS

put power to work at just the right speed

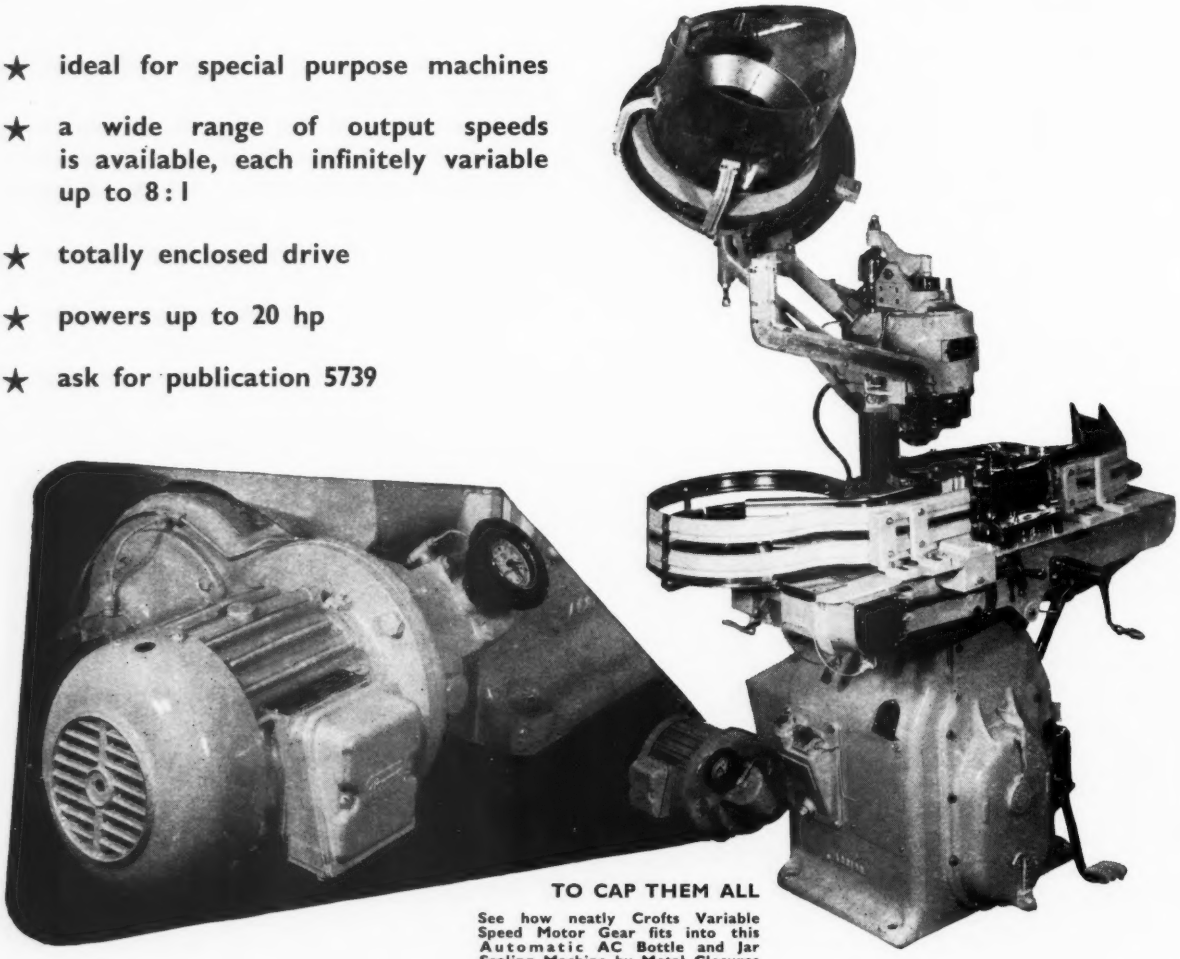
★ ideal for special purpose machines

★ a wide range of output speeds is available, each infinitely variable up to 8 : 1

★ totally enclosed drive

★ powers up to 20 hp

★ ask for publication 5739



TO CAP THEM ALL

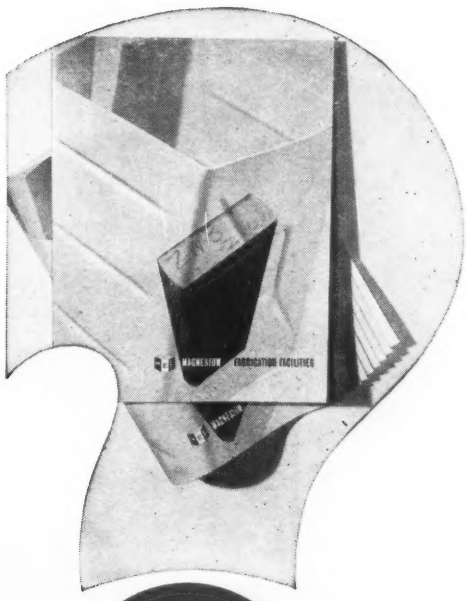
See how neatly Crofts Variable Speed Motor Gear fits into this Automatic AC Bottle and Jar Sealing Machine by Metal Closures Limited.

CROFTS (ENGINEERS) LIMITED

BRADFORD 3 ENGLAND

Tel. : 65251 (20 lines) *Grams : 'Crofters Bradford Telex'* *Telex 51186*

BRANCHES AT: Belfast, Birmingham, Bristol, Cardiff, Dublin, Glasgow, Leeds, Liverpool, London, Manchester, Newcastle, Northampton, Nottingham, Sheffield, Stoke



Have you considered

the advantages of magnesium fabrications

As part of their technical service to all magnesium users, MEL make available a wide range of descriptive literature. Whenever a strong, light, metal fabrication is being considered, an invaluable guide to the application of magnesium will be found in the booklet *MEL Magnesium Fabrication Facilities*.

More and more manufacturers are specifying this lightest of structural metals for a wide variety of fabrications. Magnesium is strong, easily welded and possesses very good deep-drawing characteristics. Magnesium machines twice as fast as aluminium, ten times faster than steel, giving an excellent surface finish. Usually no cutting fluids are required, and because of magnesium's good machinability tools have a long life.

These and other advantages of magnesium fabrications are being brought to every industry by MEL. Their Fabrication and Assembly Shops at Clifton Junction, Manchester, are entirely devoted to magnesium; they were planned and equipped with only magnesium in mind.

Magnesium fabrication is fully discussed in the booklet *MEL Magnesium Fabrication Facilities*. You can obtain a copy by writing to Magnesium Elektron Limited, 21 St. James's Square, London SW1.

kill dead weight with magnesium MEL

Cut your costs with

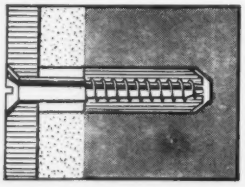
21 RAWLPLUG FIXING DEVICES

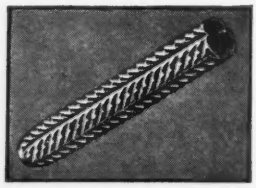
FOR SPEEDY FIXING IN ANY MATERIAL

No more trouble or costly delay because the material was 'difficult'! Whether it's concrete or plastic, breeze or sheet metal, cavity brick or lath and plaster, there's a Rawlplug Fixing Device that makes firm screw or bolt fixings quickly, easily and economically. The speedy answer to every fixing problem is one or other of the 21 different types of Rawlplug Fixing Devices. Write for illustrated brochure.

Screw Fixings

Use the famous RAWLPLUG for neat, firm fixings in brick, stone, etc. All sizes up to ¾" diameter Coach Screws. Rawlplugs are waterproof and unaffected by climatic conditions.

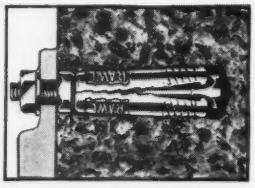


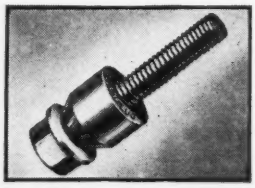


Rawlplug WHITE BRONZE PLUGS are specially suitable when the fixing is subject to very high temperatures, such as the outer brick coverings of furnaces. Use also for under-water fixtures.

Bolt Fixings

For bolting down machines, use RAWLBOLTS, a dry fixing that grips by expansion. No cold chiselling, no waiting for cement to harden. Sizes up to 1" bolt diameter.

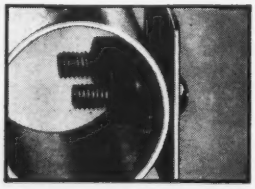


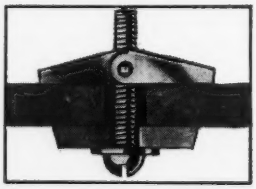


Use Rawlplug BOLT ANCHORS for bolting down in extremely wet or corrosive situations. Caulking completely seals the anchorage. Use also for anchoring Diesel Generators, Power Hammers, etc.

Cavity Fixings

Screwed up from the front the amazing RAWLNUT forms its own rivet head behind the material—airtight, watertight, vibration-proof, squeak-proof! For all thin or hollow materials.





For ceilings of lath and plaster, plasterboard, etc., use Rawlplug SPRING TOGGLES. The inserted Toggle springs open behind the material, spreading the load over a wide area.

USED BY THE MILLION THROUGHOUT INDUSTRY

RAWLPLUG FIXING DEVICES

B559

21 *different types of fixing devices for Speed and Strength*

Made by THE RAWLPLUG CO. LTD., CROMWELL ROAD, LONDON, S.W.7
The World's largest Manufacturers of Fixing Devices.

Industry's biggest names use SNOW precision grinders

DE HAVILLAND · ROLLS ROYCE
SHORT BROTHERS & HARLAND
ENGLISH ELECTRIC
BRISTOL AEROPLANES · FORD · ROVER
LEYLAND MOTORS · VAUXHALL · B.S.A.
RALEIGH INDUSTRIES · FERODO
MULLARD LTD. · ALFRED HERBERT LTD.
PILKINGTON BROTHERS LTD.
METAL BOX COMPANY
ENGLISH STEEL CORPORATION
STEEL CO. of WALES
BRITISH-AMERICAN TOBACCO CO. LTD.
BRITISH RAILWAYS

SURFACE SNOW GRINDERS

SNOW

TD.

Machine Tool Makers ... ST., SHEFFIELD 3

LONDON: 58 ... BIRMINGHAM: Dudley House, Temple St.

What d'you know ?...
ABOUT STEEL

" Mr. Mac " knows a lot . . . he and the expert staff at Macready's are available to help with any steel problems you may have. Stocks exceed 5,000 tons held in a modern store for quick despatch and our own lorries deliver over a wide area of the country.
" Mr. Mac " is at your service and your enquiries (and your orders) will be welcomed.

MACREADY'S METAL COMPANY LTD
"USASPEAD CORNER"· PENTONVILLE ROAD·LONDON·N.I.
Tel: TERminus 7060 (20 lines). Telegrams: Usaspead, London, Telex. Telex No.2-2788

This is an example of All-Welded Machine Bed Plates manufactured by this Company. The photograph shows how well the complications of modern machine practice can be overcome by this modern method resulting in great economies.

We can profile cut any shape in mild steel from ¼" to 6" in thickness. Our products are clean cut and necessitate the minimum of machining and finishing. They make for large economies in reducing the number of operations Send your enquiries to:-

Bolton Railway Wagon & Ironworks Co. Ltd.

Telephone
Bolton 4020 (3 lines)

BOLTON, Lancashire.

Telegrams
"WAGON" BOLTON

MECHANICAL TUBING
saves costs in time
labour and materials
Whether you require mechanical tubes of large or small diameters we can be of service to you, for we carry large and varied stocks of tubing of many sizes and lengths. These tubes can be supplied in various finishes and are obtainable suitable for machining. The use of mechanical tubing saves a great deal of time, particularly when manufacturing rollers and ring shaped machined parts.
Write, 'phone or call for full particulars
IMMEDIATE DELIVERY IN MOST CASES
Markland Scowcroft
LIMITED
COX GREEN WORKS, BROMLEY CROSS, Nr. BOLTON
Telephone: EAGLEY 600 (5 lines)
ALSO CONSULT US FOR—STEEL CHIMNEYS · DUCTING · TANKS · HOPPERS · BUNKERS & ALL MILD STEEL FABRICATIONS

Wimet
JIG BORING
tools
Wickman
496 ST

The Institution of Production Engineers Journal
VOL. 36 NO. 12 DECEMBER, 1957

The Annual Dinner

The Annual Dinner of the Institution was held at the Dorchester Hotel, London, on Friday, 4th October, 1957, and was attended by over 400 members and guests. The President of the Institution, The Right Hon. The Earl of Halsbury, F.R.I.C., F.Inst.P., M.I.Prod.E., was in the Chair, and the principal guest was Sir John Maud, G.C.B., C.B.E., Secretary to the Ministry of Power.

During the evening the annual awards of the Institution were announced by the President and presentations were made by Sir John Maud.

In proposing the toast of "The Guests", the President said :-

WITH all the galaxy of talent present here tonight, I shall treat our guests — I hope I am guilty of no discourtesy in doing so — as if they were minutes circulated in advance and I will ask their permission to take them as read — with one exception and that, of course, is the guest of honour, Sir John Maud, whom we are inviting to reply on their behalf.

Sir John is my friend and also a fellow member of a most delectable club where we foregather for lunch and forget the cares of this world in pleasant conversation. He was at one time my boss. Concurrently — administration is a funny game — I was at the same time adviser to his boss! Our careers overlapped at school. This experience was no doubt a shock to him, but, if so, it is the only trace I can discover of a setback in a career of otherwise unbroken success.

From Eton, where he was a King's Scholar, he went on to New College, Oxford, where he had a most brilliant academic career, which took him both to Harvard, on the one hand, and South Africa, on the other hand. On return to this country, he became Dean of University College, Oxford, and when still a stripling of 33, he was Master at Birkbeck. The War, finding him at a loose end, immediately engulfed him whereupon he found himself, first of all, at the Ministry of Food and then at the Ministry of Reconstruction.

Towards the end of the War, he became Secretary of the Office of the Lord President of the Council, in which capacity he was in charge of all the scientific affairs of the nation. Then, shortly afterwards, he became Permanent Secretary to the Ministry of Education, where he laid plans for the future education of our citizenry. Those plans will endure for a generation.

He is now Permanent Secretary to the Ministry of Power, where he and my old friend and colleague, Lord Mills, hold sway as Minister and head of the permanent officials. Personally, I can imagine no better team for the direction of the high purposes to which they are currently dedicating themselves, purposes which are of such supreme importance to those of us who are production engineers.

What shall I call their purpose ? More power ? More power to our elbow ? No. I think that that would be quite inconsistent with what we have in mind. More power to our machines would be a more appropriate description of it. I am sure

The President (standing) introduces Sir John Maud (left).

that we wish both Sir John and the Minister the very best of luck in the consummation of the plans that they have in mind.

We are told that it is possible to double the standard of living in this country over the next 25 years or so, but that is more a long-range forecast that what is customary to call a plan. How can it be done ? How can a nation which depends as much as we do upon imports double its standard of living unless it is in position to pay for very significant increases in the imports which contribute to that standard of living ? Of course, those increased imports can only be paid for by increased exports, though it is very difficult to calculate exactly what effect a doubling of the standard of living will have upon the cost of the imports which will sustain it.

For example, doubling the standard of living would not entail doubling the individual amount of food which everyone would eat. On the other hand, the great majority would no doubt eat a higher proportion of the higher-priced foods. The increase in that respect would therefore be something less than double the imports which we now eat, but it would still be an increase, On the other hand, materials such as fuel, particularly coal fuel, of which we import only a marginal quantity, would probably be imported in quantities more than double those imported today.

For this reason, it is extremely difficult to calculate exactly what effect a doubling of the standard of living would have upon the problem of paying for the imports by means of which it would be sustained. I can only predict that the increase will be very significant.

No wishful thinking

The increased exports that will pay for the increased imports will not be achieved by fiat. Paraphrasing the first Chapter of Genesis, there will be no question of : "Let these goods be exported, and lo ! they were exported." It will not happen like that. It will not happen by wishful thinking. It will not happen because it would be so nice if it happened spontaneously.

Those goods will have to be exported into competitive markets, and the battle to export them will only be won if they are highly competitive goods : goods competitive in quality and price, on the one hand, and on the other hand — and just as important — competitive in quantity and delivery date. It will be no good saying : "We could have exported the goods but unfortunately we could not make them in time to compete for an order."

Those future exports — those highly competitive goods — can only be produced by highly competitive industries : that is to say, highly efficient industries; that is to say, highly mechanised industries. And whenever we start to talk about highly mechanised industries, we must stop to think about the power that drives the machines that serve these industries. Power is the care which preoccupies our guest of honour and many of his anxieties are concerned with the enormous capital investment represented by the power stations which his programme contemplates. Production engineering in relation to capital goods is therefore of great importance to him.

A true index

There is a very interesting document which I have been studying lately. It is a document to which too few people, I think, pay attention : the collected statistics relating to the national income In this year's edition, for the first time, we are given details of the gross domestic consumption — not production — of capital in this country since the War. Previous editions have only published figures for the gross domestic production of capital. Now at last we can ascertain, by subtracting consumption from production, our national net capital formation, a true index of how productivity is being increased. Because gross capital formation, if it is in balance with capital consumption, does no more than replace what we have already got. To increase our power to compete, we must do more than that. We must add something to what we have already got.

Taking the nine years 1948 - 1956, at 1948 prices, thereby discounting the effect of any inflation which has taken place in the meantime, I find that consumer expenditure has risen by 16% over those nine years — not quite 2% simple annual increase, per year. Gross capital formation rose by 56%. Net capital formation rose by as much as 95%, although the net capital formation in plant and machinery rose by rather less than the national average, namely, by 80%

It has often been said that the consumer has been too greedy in the demands that he has made upon the national product since the War, and that industry is short of capital as a result; the figures I have quoted do not support a very strong case against the consumer.

The figures enable one, however, to show what sort of forbearance on his part could be asked for in realistic terms. He has had a 2% annual increase in his consumption. Had he been willing to forego half of that and make it 1%, we could have been installing new plant and new machinery at about three times the present rate.

A more realistic calculation

Most engineers would probably think it unrealistic to contemplate trebling our rate of plant installation over a period as short as nine years. A more realistic calculation would allow the consumer an annual increase of 1½% rather than 2%; our rate of investment in plant and machinery would on this calculation be double what it is today.

On the score of greed, then, capital's quarrel with the consumer is a quarrel about ½% in real terms. Surely it is a quarrel that could be resolved without undue stress. What seems much more serious is that the consumer has, for every £1 increase in real money, negotiated a further £2 of valueless inflationary paper.

These economic matters have an important bearing on the work that we do. That work is concerned with new engineering practice, on the one hand, and better methods of organisation, on the other. However hard we try to reorganise things, the reorganised practice must reach a plateau sooner or later, and only new engineering can maintain a continuous rise in productivity.

There is no doubt that there was room for a good deal of reorganisation in production after the War, and a great deal of unobtrusive reorganisation has in fact been going on. That phase of our contribution to productivity must be reaching its plateau, however, and increasingly we shall depend upon new engineering devices rather than the reorganisation of old engineering devices if we are to maintain the annual rise in productivity to which we have grown accustomed.

It will be particularly necessary to maintain that increase in productivity in relation to capital goods. When capital goods are installed in a factory making goods for consumption, they lead to a rise in productivity much of which is passed on to the consumers as pay packet increases. The increased wage-rates next find their way back into the capital goods industry and raise costs. Unless there is a corresponding increase in productivity to neutralise that rise in cost, machine power will become progressively more expensive than man power, and the rising price of capital goods will be a disincentive to their installation.

A challenge to the production engineer

Here then we have a challenge to the production engineer: to increase productivity in the manufacture of capital goods at least as fast as the installation of these capital goods causes an increase in productivity at the points where they are installed.

I have recently been conducting some enquiries among my friends engaged in making capital goods to see how they are meeting that challenge. I find that a number of them to whom I have addressed the question answered it in favourable terms. One of them, however, sounds an ominous note. He has doubled his productivity since the War, but analysis shows that one-third of the increase is due to new plant and machinery, one-third to better machine shop loading (what I might call micro-organising) and one-third to better production planning (what I might call macro-organising) in the drawing office and the progress office.

Two-thirds of his increase in productivity is accordingly due to organisation, a process which must reach saturation. When it does so, his annual increase will sink to one-third of what it has been hitherto. Failing new engineering techniques, my informant will thereafter find great difficulty in maintaining his increase in productivity at its old level.

"Production fights inflation" could well be the slogan of the members of this Institution, but it has to be translated into engineering terms before it can be applied. In engineering terms the automation of automation is a challenge the solution of which could give effect to it — cheapening capital goods in proportion to the increased productivity that results from their installation. And of all the capital goods we could cheapen, few could be of more importance to us and none of more importance to our distinguished guest than those involved in the generation and distribution of power, a sentiment which returns me to my starting-point, his presence with us tonight. I give you accordingly the toast of "Our Guests", coupled with the name of Sir John Maud.

Sir John Maud, G.C.B., C.B.E. (*Secretary, Ministry of Power*), in response, said :-

IN case I am inhibited from further speech at any moment, let me quickly say, on behalf not only of myself but on behalf of a very distinguished company of guests, from the Commonwealth, from overseas, from our kindred associations, from education and from the Fighting Services, " Thank you ". Thank you for what in your control engineering terms you might be tempted to call a " positive feedback ", but what I call a damned good dinner.

Thank you, if you will forgive my being departmental for one moment only, for that incredible and unusual efficiency in the use of power and steel which characterises all those who are production engineers. Thank you ! And thank you, further, for what the Lord President also referred to : the very short speech production schedule which is on the menu this evening.

We all of us know that productive industry is the most exciting profession of the second half of the 20th century, and we all know that the key men in productive industry are the production engineers. But we do not all know which the lock is of which the production engineer holds the key !

Therefore, I ask myself, who are the production engineers ? For an answer, where should I more naturally turn than to my left hand, to your President, Lord Halsbury ? He is not an engineer ! He has not produced anything in his life, except children ! He has so many keys in his locker that I do not know which of them is the production engineer's.

But I say with pride that he is an old Etonian. We have recently been told by the new Minister of Education, Mr. Geoffrey Lloyd — a Harrovian — that he is the first science specialist ever to have been Minister of Education. Gentlemen, your Lord President is Eton's answer to Harrow ! I take a pride that it was I who called him to one of the most important public services which he still performs. It is unknown to you, perhaps, but he is the Chairman of " Smac ". You do not know what S.M.A.C. is, even though you are production engineers ? I will tell you. I have the key to that lock. S.M.A.C. is the Science Museum Advisory Council.

What is a production engineer ?

But he is also the managing director of the National Research Development Corporation, and here we begin to come to the answer to our question : What is a production engineer, and to which lock has he the key ? The National Research Development Corporation has to sort out a very large number of better and worse ideas that come to them from — do not let us say production engineers, because they do not have worse ideas, but from scientists and technologists who think that they have ideas which should be developed but which they cannot get anybody to risk their money in developing.

So they come to the National Research Development Corporation. And what technique has your Lord President devised to sort out the better from the worse ? It is an electronic computer, gentlemen, something which you have not yet heard of, called H.A.L.S.B.U.R.Y. Do not misunderstand me. Just as the Postmaster-General the other day disclaimed any connection at all, although his name was Ernest, with that electronic computer called " Ernie ", which was solely called after the initials E.R.N.I.E., whose meaning I have temporarily forgotten, so " Halsbury " has nothing to do with the managing director of the National Research Development Corporation, but is the initials of that very simple device, the High and Low Speed Bloody Useless Research Yardstick !

Mr. Stafford Beer (left) receives from Sir John Maud an engraved silver salver for his George Bray Paper on " The Scope for Operational Research in industry ".

The problem of what is a production engineer, one would have thought, would have been sorted out by this machine, which with imperfect mechanism sorts out the better from the worse — it served the National Research Development Corporation very well; but it is being perfected and will shortly give place to a new electronic computer called, not after the first name of your Lord President — do not misunderstand me — and not after a home perm, but nevertheless called "Tony". And what is "Tony"? It is something that will be of great value not only in sorting out the better and worse ideas that come to our National Research Development Corporation, but perhaps to party conferences, Sir Vincent — perhaps to party conferences next week, Sir Norman — something that may even be used in Whitehall, although I understand the Treasury have already put in a rider saying that they cannot afford it. The "Tony" is the Too Outrageous Nonsense Yardstick — which I am very grateful to your Lord President for having perfected and which I hope very much, in spite of Treasury opposition, we shall shortly install and will make my own work and that of Lord Mills unnecessary in the future!

No clear answer

As you see, one has no clear answer to "What is a production engineer" when you look at someone who obviously is a production engineer and who, indeed, is your Lord President. Therefore, I turn to those who are presumably not production engineers, because, as we all know, the negative test is a very valuable one and the positive one has not been successful. Your guests have at any rate this in common, that they are not production engineers, otherwise they would be paying for their dinner!

So I look at Sir Norman Kipping, on my right, to explain to me what is a production engineer by not being one, and I find he has been one all his life. Therefore, I turn to myself — I am sorry, gentlemen, if I turn to myself, a poor bureaucrat — and I ask, can a bureaucrat be a production engineer? Well, I have this in common with your Lord President, that I am not an engineer and I have never produced anything; but nevertheless I must admit that I find that my daily work is not unsimilar to your own, because the purpose of the Ministry of Power is precisely what all of you are doing day by day in your individual industries.

The purpose of the Ministry of Power is to see to it somehow that the nation has the power and steel that it needs to match the expanding economy, at the least real cost to the nation, in the right quantities, in the right qualities and at the right time. That is, in fact, what Lord Mills and those of us who help him are trying to do for you.

Furthermore, it is our technique to see that each of the industries for which we are responsible in any way has got a production schedule, a master plan, which is based on assumptions that we, on behalf of the nation, determine on assumption about how much more fuel we shall need in 1960, in 1965 and in 1970. We, therefore, have a coal production development plan, an electricity and a nuclear power development plan, a gas plan and an oil plan, which will together, with luck, match the needs which all of you produce, if you are spared, in the course of the next 10 or 15 years. We go also into 'detailed' schedules and calculate how far it will be possible, with this or that capital investment, to provide the jigs and the tools which will enable those fuel industries and the iron and steel industry to do what is required of them.

Furthermore, we look at organisation. Recently, Parliament passed a new Electricity Act. That was because we had asked Sir Edwin Herbert and a band of experts to look at the electricity supply industry and, in the light of the last 10 years' experience, to see how far we could improve the structural make-up of that nationalised industry. Thus through Parliament we have given Sir Christopher Hinton, Sir Henry Self and the other people who form these new boards the chance of doing even better for the nation in electricity supply over the next 10 years than their predecessors have done since 1947.

The field of human relations

But our chief job is in this crucial field of human relations—the job of trying to create conditions in which the best men we can get to run these industries work under conditions which will enable them to have increasingly a sense of responsibility and a sense that they have got time to do their job without each moment feeling someone, whether a Member of Parliament or a Member of the House of Lords, breathing over their shoulder and asking them whether over the last 6 or 12 months they have done what they should have done. Those, I believe all of us here would agree, are the only conditions in which anybody can do a production job. Those are the conditions that Lord Mills and the Ministry of Power are trying to create for these fuel industries on which, as your President has said, the increasing productivity of the country very largely depends.

And so, in replying to this toast and in thanking you for this wonderful meal that we have all had and the good fellowship which has been shown round this table, I find myself in fundamental sympathy with you. I would never dream of asking you to admit me as even an outside allied Associate Member of The Institution of

Production Engineers. But do not forget that we poor bureaucrats are, in fact, trying to help you. However little we seem to succeed and however little we achieve in our sphere compared with what you achieve in yours, in fact, our ends and our methods are very largely the same.

The distinguishing mark

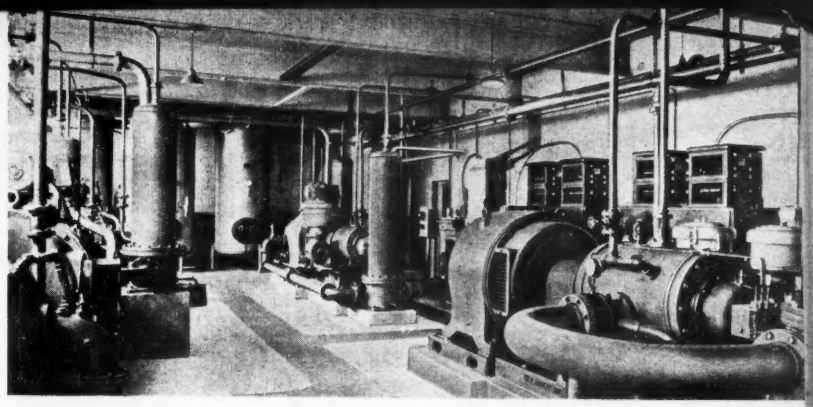
For when it comes to the final analysis, I believe that the distinguishing mark of the production engineer, as distinct from the bureaucrat or from any of the other people who are your allies, is this. You are a trinitarian type. You are three experts in one person.

You are a technologist who has experience of the workshop and knows at first hand how things are made and can be made. Secondly, you are an economist; you are cost-conscious. You know how important it is, when deciding how to make a thing, to ask exactly what the net return will be for a given quantum of investment. Thirdly, you realise that it is not only machines that make things, but that it is men; so that what makes you a production engineer is your concern to marry men and their motives with the machines that you can give them — with proper consciousness of costs.

In a world which is exceedingly and increasingly compartmental and divided up among a lot of separate specialists who do not know each other's business, you stand for the idea of being more than one sort of expert, of being someone who contains within himself three separate professions : that of the technologist who wants to apply science to production, that of the economist who wants to produce at an economic price, and that of the manager who wants to produce by giving people the chance of working together — not merely working harder, but working in sympathy with one another, understanding their work and, therefore, making a contribution bigger than they could otherwise have made.

So in conclusion, I want to remind you, or to inform those of you who did not read *The Times* yesterday, that a very important purchase has recently been made, by the Birmingham Museum and Art Gallery for a mere £700, of the skull of a triceratops. You do not know the triceratops ? This skull was dug up in Nevada some time ago and is the skull, so thick that it measures a mere six feet and weighs no more than half-a-ton, of one of those well-mannered grass-eating dinosaurs (to quote the limpid language of *The Times*) which I, when I first read of it, assumed to be the prototype of a top civil servant — particularly when I realised that it had "a bony frill to protect its neck " against Ministerial censure.

On reflection, however, I realised that the triceratops is the prototype of the production engineer because, although it looked like a rhinoceros, in fact it had three horns, And, furthermore, this trinitarian type we can accept not only as the prototype of you our hosts, but as that of your guests too — for the Fighting Services have three horns too. So whether or not we are well-mannered — in other words, whether we are in the public or the private sector — and whether we are poor bureaucrats who never produce or key men who open the lock of improved production through better understanding between all the factors involved, we all of us have a wonderful challenge in our present discontents. Our common answer to inflation is increased production—and to hell with cuts and unemployment !



Compressed Air — A User's Experience

by John Smedley and W. G. Wood

IT has been said many times that there is good and bad in all things ; compressed air is no exception. Experience in its use is based on finding the good and bad features, the advantages and disadvantages.

Some of the disadvantages encountered are not new or peculiar to any one application, but have always been associated with compressed air. Other disadvantages are not wholly attributable to the compressed air, as such, but are created by the conditions and methods in which it is used. The type of factory and the layout of the air service system are further sources from which troubles may originate.

In considering the kind of troubles to mention, an attempt has been made to bring out those that apply generally, but a few, especially those for which illustrations are included, are peculiar to the light or medium class of engineering, although the principle may well reach across to other industries.

The advantages of compressed air are to be found in its use in reducing operator fatigue, in speeding up cycle times of machines by air-assisted movement of tools to and from the work, and in a host of similar applications too numerous to be covered in any one Paper.

The compressor

The compressor is the heart of a compressed air system and may have been designed on a rotating or reciprocating principle. Both types have their individual merits, but it cannot be said they embody all the desirable features that would be found in the 'ideal' compressor, the characteristics of which would be :-

(a) economy of operation;
(b) ease of installation;
(c) freedom from vibration and pulsation noises;
(d) requiring the minimum of maintenance;
(e) capable of supplying air free from oil and water.

If the present-day compressors are compared with this list, their shortcomings are clearly shown; it also provides a basis from which a comparison of the two types can be made, the findings being :-

(a) That the cost of compressing air is still high, as will be seen from the cost analysis of four compressors (Table I). Of the two types, the reciprocating compressor is the most economical to run.
(b) Installation problems are easier with the rotary compressor. The foundations are simpler than those required for reciprocating compressors, also a much neater form of layout can be obtained, as illustrated at the top of this page.
(c) The maintenance problem is not easy to discuss as it depends on so many factors, but it is generally considered that the rotary compressor has the lower maintenance cost of the two types.
(d) Noise is definitely a feature of the reciprocating compressor and is often complained of by operators who have to work within the noise range.
(e) Oil and water in the air supply in some instances can be helpful, for example, in lubricating air operated motors or tools, but in others it is a disadvantage as will be plainly evident when the journey of the air through the system is followed.

Having made the comparison between the two types of compressors, it is not proposed to recommend one in preference to the other, but to leave that to the individual 'user', who must judge them on their ability to meet his own particular requirements.

Table I. Cost analysis of compressors.

Capacity	*Type*	*Average Capital Cost (Compressor only)*	*Running Cost*	*Power/Output Ratio*
1060 c.f.m.	Water-cooled rotary	£5/c.f.m. free air	0.005d./c.f. free air	4.75 c.f.m. free air/H.P.
980 c.f.m.	Water-cooled reciprocating	£5.15/c.f.m. free air	0.0046d./c.f. free air	5.25 c.f.m. free air/H.P.
550 c.f.m.	Oil-flooded rotary	£4.6/c.f.m. free air	0.006d./c.f. free air	3.9 c.f.m. free air/H.P.
420 c.f.m.	Water-cooled reciprocating	£4.76/c.f.m. free air	0.0045d./c.f. free air	5.4 c.f.m. free air/H.P.

Mr. Smedley has been with Rolls-Royce Limited for 38 years. In 1936 he was appointed Supervisor of the Electrical & Mechanical Department of the Nightingale Road Works, Derby.

After the outbreak of the last War he was appointed Manager of the Rolls-Royce Dispersal Factory at Ashbourne. He remained in this post until 1944, when he took over the Newcastle-under-Lyme Factory, where the Rolls-Royce gas turbine engine was first produced.

Two years later he had returned to the Main Works at Derby as Deputy Works Manager and became Works Manager in 1950, and towards the end of 1954 he was appointed to his present position as Chief Production Engineer.

Mr. Wood served his apprenticeship with Rolls-Royce Limited. After completing his National Service he spent two years in the Planning Office, followed by a period in the Process Development and Quality Control Departments. He joined the Chief Production Engineer's Staff in 1955.

Air lines

After the air has been compressed and passed through the air cooler, to remove much of the water content, it passes to the storage tank and from there *via* numerous pipes to the point of application. Before proceeding to the shop floor it is worth while stopping to consider some of the problems that are encountered in the air line system, for it is here that the first effects of oil and water are felt.

At various stages in the air line, drain taps are fitted to catch the water that has condensed from the air. These traps are fitted with automatic draining systems, the working parts of which, unfortunately, become coated by oil emanating from the compressor. After a period of one to three months the oil coating, unless removed by carrying out maintenance on the drain, will gum up the working mechanism. This will result in the air having a high water content unless drained away from the trap by some other method. One way of doing this is by manually-operated drain valves bled once or twice per day. Whenever possible this system should be avoided, because of the extra work involved. Several makes of drain tap have been tried in the hope of overcoming this problem, but only small improvements were found. It is, therefore, essential that an effort be made to produce a drain tap that is capable of working under these conditions for a longer period than those at present available.

Oil is also detrimental to the rubber hose that is commonly used for connecting the air appliance to the feed line. This problem need never arise when it is considered that there are oil-resistant rubbers available. For some reason the user, in general, does not seem to have taken advantage of these rubbers but continues to use the perishable type of hose, even when the machine is using the heavy grades of cutting oil that attack the rubber very quickly.

Air leaks from the air lines, although normally accepted, can be a very costly item. In a recent test carried out at a factory using air at the rate of 4,460 c.f.m. at 100 lb./sq. in. and 800 c.f.m. at 30 lb./sq. in., it was found that the leakage was 600 c.f.m.; when this is converted into costs, it means that approximately £5,450 is lost per year of 48 working weeks.

Having brought the air to the workshop the advantages to be gained from it can be explored, and for this purpose illustrations of five appl cations have been included here. To the specialist these will appear simple and perhaps somewhat crude, but experience has shown that it is the simple application that usually pays the greatest d vidends, as the cost of such a layout is small and quickly reclaimed. At the same time an appreciable saving in cycle time and effort on the part of the operator can be obtained.

Applications

Fig. 2 shows an extrusion being forced from the die through the med um of a compressed air cylinder acting on the end of the component. As the load on the extrusion can be infinitely varied by controlling the air supply to the cylinder, the part is pushed back through the die at a controlled speed; this allows time for the press operator to grip the head of the extrus on, in a pair of tongs, so that when clear of the extrusion die he can transfer the piece to a heading die, housed in the same bolster, and complete the heading and extrusion operation. Air is also used in removing the part after heading, but in this instance it is done through a build-up of pressure, which on overcoming the retaining friction

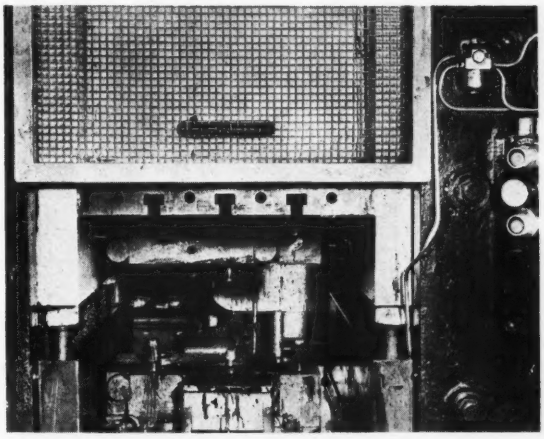


Fig. 2. An extrusion being forced from the die through the medium of a compressed air cylinder acting on the end of the component.

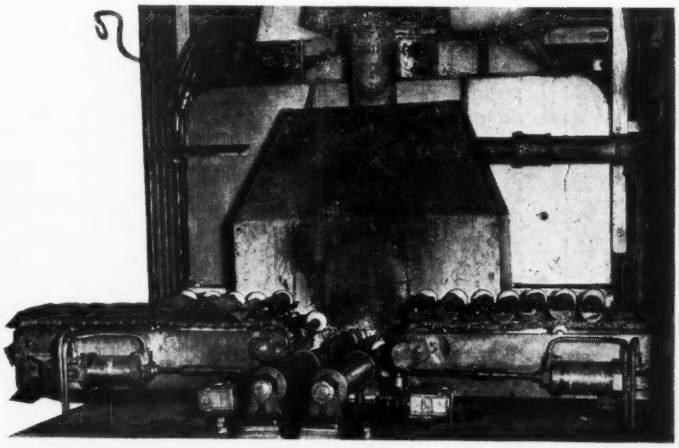


Fig. 3 (left). Furnace with air-operated conveyor and rams.

of the die, blows the component some six inches clear of the die. Originally this system was used to free the extrusion, but as will be appreciated, was too difficult to control, as the operator had either to catch the part as it left the die or retrieve it, on coming to rest, before placing it in the heading die to complete the operation.

The advantage of air over mechanical extraction of the extruded component lies in the ability of the air system to exert an increasing load, as against the direct load applied by mechanical extracting mechanisms. A direct load acting on the end of the extruded stem has a tendency to peen the end over, which results in jamming or damage to the bore of the die when this portion of the extrusion is being returned.

The air cylinder and chamber, for building up the pressure, are housed in the under side of the lower bolster and the well of the press. The air cylinder for freeing the extrusion is actuated by the control lever on the right-hand frame member of the press, the build-up of pressure being operated through a foot pedal lever at the base of the left-hand frame.

After a small amount of machining the component is heated in a through feed furnace prior to stamping. It is fed into the furnace by air-operated rams, as shown in Fig. 3. The two conveyors, also air actuated, on the right and left-hand side of the rams, operate alternatively and tip the component into a feed trough at the entrance to the furnace. The timing of the conveyors and the rams can be controlled by an electric time switch or by push button control. The latter is the method normally employed. The cycle is initiated by the press operator pressing the push button control, which is positioned within easy reach

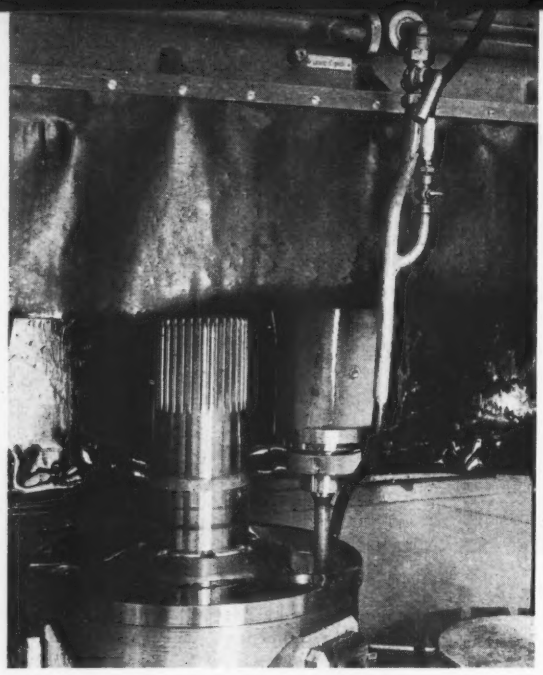


Fig. 4. A compressed air line has been let into the coolant pipe on this milling operation, so that metal chips are blown away.

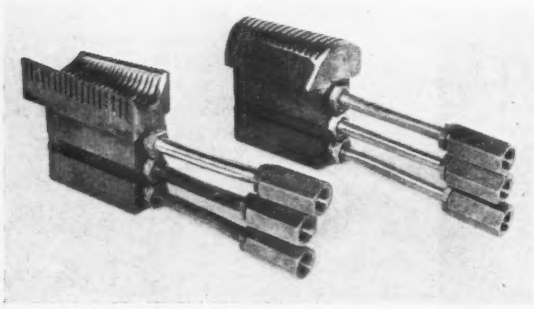


Fig. 5. Matrix type formers.

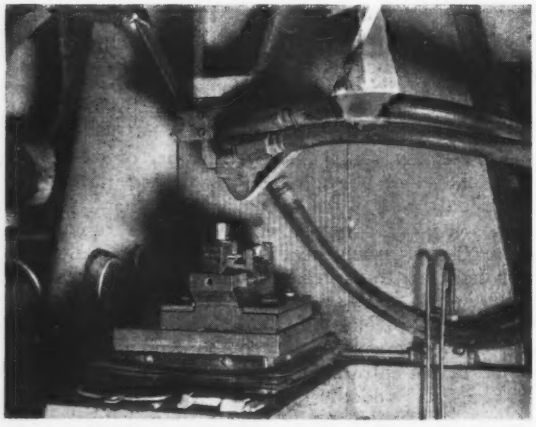


Fig. 6. Air controlled blade polishing — the fixture is here shown in the loading position.

of his operating position, normally on the side of the furnace at the end away from the conveyors. The electrical control system allows the air to operate either the left-hand conveyor and the right ram, or the right-hand conveyor and the left ram, dependent on which feed trough was last filled. In this way the part is pushed into the furnace by the ram.

When the furnace is filled to capacity, each time a fresh component is fed in, one will fall out of the furnace at the other end into a chute, and is ready to be placed in the press for stamping. Prior to the introduction of these conveyors the parts had to be heated in an open face furnace, charged to capacity. Whilst the parts were being heated to their forging temperature the press stood idle, but when up to temperature it was necessary to stamp the batch before loading further parts into the furnace, as the soak time of the part is critical. As no fresh parts could be placed in the furnace, the delay whilst a new charge was heated took place once again.

An alternative method

An alternative method of using the through feed furnace can be employed when no conveyors are fitted, the parts under these conditions being rammed manually, but this requires either an extra man to push the parts through or one of the press operators to be continually moving to the rear of the furnace to perform this duty.

A disadvantage to the compressed air application is caused by the heat from the furnace, as in time, under these conditions, it destroys the piston gland. It had been suggested that a gland of heat-resisting material be used to overcome this handicap, but no trials have as yet been carried out.

The remaining illustrations on the use of compressed air are taken from the machine shops. Fig. 4 is the simplest of these applications, but one that has proved successful when milling deep hole pockets. One of the problems is to find some method of removing the metal chips, which if allowed to remain throw extra work on the cutter and, in time, as the quantity of metal removed from the component increases, chokes or clogs it. Under these conditions the cutter cannot work efficiently. From the illustration it will be seen that a compressed air line has been let into the coolant pipe. The air, when turned on, is fed into the coolant so that a pressure fed coolant is directed into the pocket. This will blast away the chips and, unless the pocket is very deep or confined, impart sufficient force to drive the chips from the pocket.

A design problem

The next example is taken from a mechanical blade polishing machine. Before this machine could be introduced, one of the design problems that had to be solved was how to keep the abrasive belt against the aerofoil shape. Several methods have been employed on this duty in the past, all of which have now been replaced by the use of compressed air. This was achieved by passing the air through a matrix type former, illustrated by Fig. 5. The former block consists of three separate slotted chambers, each

chamber being supplied with air by its own pipe. The three supply pipes can be seen in the illustration. When the machine is operating only two of the chambers are in operation at any one time; this is dependent upon whether the polishing is taking place at the root or shroud end of the blade aerofoil section.

The blade to be polished is mounted on a fixture as shown in Fig. 6. Here the fixture is seen in the loading position. It is retained in this position by an air cylinder acting against a weighted lever. To move the blade to the operating position for polishing the air cylinder is exhausted. The weighted lever will now re-assert itself and in doing so force the housing, to which the fixture is attached, upwards, until the blade is in solid contact with the abrasive belt, which can be seen against the former; this action has now trapped the belt between the blade and the air former. The air supply to the former is then turned on; this is of sufficient pressure to force the abrasive belt uniformly against the aerofoil surface of the blade. The pressure also pushes the blade and abrasive belt away from the face of the former by a few thousandths of an inch, so that an air cushion exists between the back of the abrasive belt and the face of the former. This small movement is maintained by the balance that now exists between the action of the lever and the pressure of the air passing through the slots in the former.

Polishing of the blade

Polishing of the blade is achieved by a pull first one way and then the other on the abrasive belt, so that the belt is pulled across the blade in one direction and then returned. To ensure that the belt does not become slack when the pull is reversed, the belt is tensioned by passing it over a series of sprockets. The sprockets are controlled by two air cylinders that act upon each other in accordance with the see-saw motion of the machine. As one cylinder exhausts the other fills, and dependent on the movement of the cylinders is the tension of the sprockets on the abrasive belt.

There are two disadvantages in using compressed air in this application. One is that the oil and water content in the air weakens the abrasive belt, and the other is the reduction in efficiency of the dust extraction plant. The reason for this is that the pressure of the air escaping from the former is greater than the suction of the extraction plant, so that the dust, instead of being drawn into the entrance of the extraction plant, is blown away from it. Fortunately the dust does not carry beyond the loading entrance of the machine.

The final illustration, Fig. 7, is of a modified oil operated tracer unit fitted to a vertical boring machine. When this profiling attachment was operated hydraulically it was necessary, after using the tracer head, to disconnect the oil supply, so that the turret could be indexed and to return the piston in the hydraulic cylinder manually to its starting position. The result of this action was the ejection of the oil remaining in the cylinder, the oil running over the machine. By modifying this system, air has replaced the oil, and although it is still necessary to remove the air pipe when the turret is indexed and return the piston to the start position, the mess experienced with the oil unit has been overcome.

Other applications

There are, of course, many other applications in the workshop to which air has been harnessed, air guns, air clamping, air hoists, air gauging and so on, all of which are studies on their own but which will have to be covered in this instance by a very brief reference.

The air gun is probably the most commonly used of all air-operated appliances. It can be used from drying components that have been immersed in water or some other liquid, to cleaning down machines by blowing away the swarf. However, let us not forget that these applications have certain risks, which under some conditions can be a source of trouble. The air contains a water content, as already mentioned, and sometimes oil, both of which may be harmful when drying components. When cleaning machines the air may blow particles of swarf into the slideways and cause damage. Another fault with air guns is their habit of remaining on, or partially on, when not in use; in this way a large amount of air is wasted.

Air clamping is, of course, a big saver in time and effort, but it is still looked upon by a large number of operators as being unsafe, despite the addition

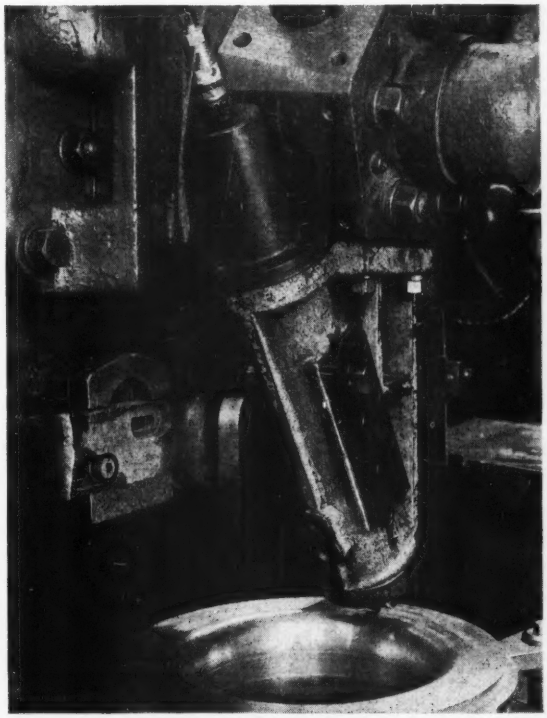


Fig. 7. A modified oil operated tracer unit, fitted to a vertical boring machine.

of mechanical locking devices to the clamping action which ensure the retention of the part should the air supply fail.

Recent advances

Air gauging in recent years has made many advances in production inspection techniques. The big drawback with these methods is the possibility of oil and water from the air supply getting into the gauging system. This condition was experienced on a machine designed for inspecting the dimensions of compressor blade aerofoil sections, despite a filtering system fitted in the circuit. The problem was overcome by bleeding the air for the machines from a point in the main air supply system at a greater distance from the air compressor than in the first instance. By re-tapping the supply pipe at a greater distance the oil and water content had reduced and could be filtered successfully.

Air gauges for checking internal diameters have proved very helpful in checking bores that are required to have a finish free from tool marks, as checking the part in this way overcomes the risk of marking the bore, as is experienced when plug gauges are used.

The smaller range of air-operated tools, such as drills and nut runners, is in everyday use. With air drills a big point in their favour over electrically-operated drills is that the possibility of the drill becoming 'alive' through some electrical fault and thereby electrocuting the operator does not arise. Nut runners of single and multi-type designs assist in reducing operator fatigue, but these tools have the disadvantage of being very noisy; this applies especially to the multi-nut runners. The noise is caused by the air passing through the exhaust of the tool to the atmosphere.

Agitating of plating vats by compressed air is another well-established practice. In this instance it is important that only air free from oil is used. To ensure that this is so the air is supplied by compressors designed for this purpose. It is appreciated that larger models of these compressors are available and could be used for general air supply purposes, but to do so is considered too expensive.

Dangers of compressed air

Unfortunately the use of compressed air introduces certain dangers on account of the very rapid movements that are obtained. Air hoists are an example of this, especially when lifting or lowering heavy castings. Experience of air hoists has shown that they are inclined to snatch or lower a part more quickly than the operator can react. Because of this, extreme caution has to be exercised to prevent the part bouncing against the machine; this could cause damage to component and machine. The worst thing that could happen would be the trapping of the operator by the part. This is not out of the realms of possibility when he is guiding a large and hefty component on to a spigot or some other form of location. Because of this danger operators prefer to use chain-operated cranes for this kind of work, as they can be controlled more accurately. A similar danger exists with the use of air clamps, as should the operator find himself trapped, the clamping action is so quick that he receives the full clamping force before he can take any action. Usually it is only when the full clamping power has been asserted that the operator realises he is trapped, by which time it is much too late fo remedy the accident.

Supply problem

On that note we will leave the workshop and turn to the supply of compressed air units. A big problem that faces the user is the delay caused by standard parts not being readily available. Often delivery dates are anything up to three months from the placing of an order. It would, therefore, be a great help if the manufacturers could see their way clear to carry sufficient stocks of these units to supply them off the shelf.

Conclusion

The disadvantages of compressed air systems have been discussed. The ways in which a 'user' has applied compressed air to his particular problems have been illustrated. What are the lessons that can be learnt from this experience? From the user's angle there are four important ones:-

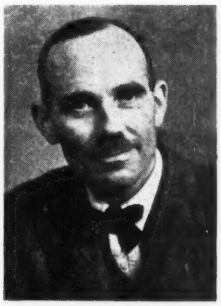
(a) that the cost of compressed air is high;
(b) to reduce the wastage of air through leakage, improved circuits and connections are necessary;
(c) oil filter and water traps require further development;
(d) that consideration is given to safeguarding the operator when air appliances with rapid action are used.

Most of the work involved to improve these features falls upon the manufacturers of air equipment, but they cannot solve all of the problems on their own. That can only be done by collaboration between the user and manufacturer and in that way only will the best advantages of using air as an 'Aid to Productivity' be obtained.

Some Aspects of Automation

by A. L. Stuchbery, M.I.Prod.E., M.I.Mech.E.

Presented to the London Section of the Institution at Brighton, on 5th February, 1957.



Mr. Stuchbery, who is Chief Technical Engineer of the Metal Box Company Limited, has been a member of the Institution since 1924, and has served on many of the Standing Committees and also on Council. He is currently a member of the Finance and General Purposes Committee, of the London Section Committee, and of the South-East Regional Committee.

He is a past Chairman of the London Section.

WHEN I was invited to give this lecture, it seemed appropriate to examine the historical aspect in order to obtain a proper perspective and then to consider some of the economic aspects and the human considerations which go with them. The tremendous amount of interest which has been focused on the word " automation " has led to many misconceptions and one of the dangers is that wrong impressions may be formed, which can stimulate extremely harmful reactions.

According to many people " automation " might be considered as a direct product of electronics and similar techniques, but while it is true that there are many directions in which electronic aids can refine previous practices, it would be wrong to assume that " automation " in either a wide or narrow sense is so dependent.

" Automation " is, of course, a very new word and it is important that we should be clear as to precisely the meaning we want it to carry. As I understand the term, it was originally conceived as the handmaiden of mass production. Whereas mass production has been concerned with designing skill into machines and processes, rather than man, automation was to be concerned with taking the burden of labour away from the tasks of attending the machines. Whereas mass production was concerned with mechanisation perhaps by operation, automation was to be concerned with flow, with the balancing of operational needs into an integrated process and the overall control of those processes. In this sense, automation becomes the second power of mechanisation. If you like, mechanisation of mechanisation, or perhaps it may be better described as the making automatic of mechanisation.

As we know, mass production or mechanisation has been developed to the point at which many operations are carried out so speedily that a reduction of the actual machining or process time no longer gives scope for economy. At the same time, the problem of feeding work to and from machines has become relatively more onerous. So, indeed, has the inter-operation work in progress and all the problems that go with stagnant pockets of work in progress. Accordingly, we arrive at a point where a great consensus of opinion regards it as essential that the mechanisation by operation shall be superseded by integration of those mechanised operations into larger processes, by providing automatic means of inter-operation feeding, automatic means for maintaining balanced flow, automatic means for maintaining the quality of output from the processes, and so on.

Now, regarding automation as the making automatic of mechanisation, we may ask ourselves how far this represents new industrial concepts and how far it is purely evolutionary. Mechanisation is generally regarded as the product of what we call the industrial revolution. The industrial revolution has itself a span of, say, 200 years, but it might be said that the last 75 or 80 years have seen the real development of mechanisation and especially from the parallel, or almost parallel, inventions of popular steel production and the production of electric power.

The development of mechanisation

This period of either 80 or 200 years is itself insignificant when compared with the period during which mankind has developed or acquired high degrees of skill in the field of designing or creating things. It is not the fact that over this period there has been any marked improvement in the quality of the ironmongery which man can create, but rather that its tools, or mechanisation, have enabled him to make that same sort of ironmongery at incredibly increased speeds for the advantage of immeasurable numbers and at almost infinitely reduced cost in terms of man time.

Beyond this vast field of mechanisation it must be agreed that during the last 100 years or so there are many examples of mechanisation being made automatic. There are many examples of what we now call " automation." At the beginning of the 17th century the earlier inventions had already made sheet newspapers possible—an obvious example of mechanisation. In 1847, the *Times* installed a multi-cylinder machine where eight operatives fed sheets radially to a central printing cylinder and by this means no less than 10,000 sheets per hour were produced. Within about 10 years of the installation of this machine the first reel-fed newspaper machine was built, from which the modern machine has evolved, and as is generally known, the modern newspaper press incorporates a multiplicity of printing units automatically connected between themselves and between folding, cutting and batching elements, so that in fact up to 50,000 complete newspapers, each perhaps consisting of 48, 64 or more pages, can be produced per hour and under conditions of automatic self control as to speed and register between units.

Automation in food preservation

The tin box has been produced as a container over a number of centuries and no doubt its production by tinsmith methods involved some mechanisation. At the beginning of the 19th century, Nicholas Appert discovered the process of hermetically closing food within a container and subsequently sterilising it, after which it would keep indefinitely. It was not, however, until late in the 19th and perhaps mostly in this present century, that the production of tin cans for process food preservation has really been made automatic. The present position in this industry is that the many operations required to produce hermetically sealable and sterile tin cans is carried out virtually without human intervention at speeds of the order of 300/400 per minute and, indeed, in the United States no less than 4 million tons of steel *per annum* finds its way into tin can production.

Another example is the manufacture of cigarettes, where the modern machine prepares the tobacco, brings it in controlled feed relation with the continuous web of paper and, progressively, operations of printing, applying of cork tips or filters, the applying of the tobacco, the rolling into continuous stick, the sealing of the paper joint, the cutting into accurate lengths and depositing in finished cigarette hoppers, are carried within the compass of one machine and carried out at speeds of the order of 1,500 pieces per minute.

In all of these examples, we have all the paraphernalia that goes towards what we currently conceive to be " automation." We have the integration of a large number of individual mechanised operations into completely balanced processes. We have the automatic means for maintaining flow between these operations, automatic means by which, if the flow becomes interrupted for any reason, one can automatically take appropriate action down the line and in due time sequentially start the whole sequence, and automatic means which will monitor the process and ensure not only safety for the machine and its operator, but maintain the integrity of the process itself.

Many other examples

There are, of course, many other examples of automation and it may be said that the examples I have chosen represent some of the largest consuming items which we produce today. However true that may be, it is equally true that the principles which are adopted are equally well applicable in many other fields.

In these examples we see the development of automation in parallel as the complement of operation mechanisation and certainly this automation had arrived at a very advanced state on purely mechanical grounds, and long before the appearance of electronics. For this reason, I think the idea of automation as the making automatic of mechanisation is the most appropriate one.

The advent of the modern techniques of electronics and the use of radioactive isotope techniques naturally sharpens the tools hitherto available for either mechanisation or the making automatic of mechanisation, and in sharpening these tools it not only can refine a control operation in terms of accuracy, but it can increase tremendously the speed of response of the controlling means. Thus, the methods of process control, by modulation of detecting means about the required mean of performance, are greatly assisted by electronic applications.

An excellent example of this is in the means for continuous weighing of the cigarette stick by use of Beta Ray techniques, against the earlier method of

continuously sampling the output of the machine into mechanical weighing devices, when the speed of response was naturally slow.

In the same way, the harnessing of electronic circuitry to the photo electric cell has improved the performance of register devices on printing machines which hitherto have been used for a long time.

The basic dynamic

It is not my intention here to discuss the various considerations which lead to the sort of integration in production which can justly be called " automation," but I do wish to show that the concept of automation as the second power in mechanisation naturally brings it into the general evolutionary pattern of mechanisation itself, and thus, it is an essential part of process development in mechanisation, which has been the basic dynamic in the industrial revolution.

If we are so to consider automation, we may properly ask why it is that quite suddenly this word should receive such widespread attention. If it is true that it has been developing as part of the evolutionary pattern of process development over the last 100 years or so, why do we suddenly focus tremendous public attention on the necessity for a wide expansion of its principles ?

Its popular appeal undoubtedly stems from two very human aspects—the first is the need to satisfy enormous increase in demand for items of production which may hitherto have been regarded as luxuries but are now regarded as necessities and the other—a rebellion against allowing the human attendants on machines with insatiable appetites being reduced to the status of robots. Although we live in a period of immense change, it is difficult for the man in the street to appreciate the magnitude of that change, since his own background of experience is too limited and it is only the student of history who can properly visualise the rate of change against a proper background. It is true, therefore, that the productions which have so far been made almost completely automatic are themselves taken for granted and the practices and principles tend to be overlooked. On the other hand, in those vast fields of production which set out to satisfy consumer needs, it is clear that the only possibility of satisfaction at the right price under conditions of full employment requires the rate of increase not only to keep pace with an increasing population, but to keep pace with an ever increasing level of requirements over the whole of that population.

Economic considerations

Passing now to the economic considerations, I propose to deal with these under three headings. The first, and perhaps the simplest, is in the narrower field of the process itself ; the second is in the wider field as affecting the nation and third, the still wider aspects of international economics which are crowding increasingly upon us.

The weighing of the factors affecting manufacturing efficiencies may be complicated by many factors, but in the main the results are reasonably obvious and immediate. The savings in production costs due to increases per man hour or more per unit of floor space, the savings due to reduced work in progress and stocks generally, the savings due to reduced overall process time, reduced spoilage and probably reduced material consumption, have to be considered against increased indirect and administrative costs, increased capital investment and higher maintenance, together with the risk of plant redundancy where high specialisation of equipment may be outdated by changes of fashion or product, or by competitive development. I have suggested that the manufacturing method, however far advanced it may be, falls naturally into the evolutionary pattern of mechanised production and, therefore, the considerations in this field will follow the pattern which has hitherto been developed over the last 100 years or so. To these considerations, of course, we have many refined techniques, particularly those concerned with automatic control and monitoring, so that the production engineer needs not only to develop the principles which have been fundamental to mechanisation in the past, but he must be equipped and serviced by the developments of science which undoubtedly will sharpen his tools immensely. In the purely mechanical sense, although many control operations are not only possible and have been used for many years, there can be no doubt that many of these can themselves be refined, not only in the accuracy of their operation, but also in their speed of response by the appropriate blending of electronic and other similar modulating and switching techniques.

Another important factor

This mechanical approach is, however, by no means the most vital. To it must be added the human considerations which will stem not only from those engaged in an industry, but those, equally important, who support it as its customers. The techniques of market research are today developed to the point at which really solid evidence can be provided on which to base decisions. There can be no doubt, however, that as automation grows, the units of production must tend to become still larger and more combinations in a given field must be expected and, therefore, the decisions themselves become more important. The sacrifices which this may mean, in terms of less consumer choice in details and, perhaps, in the competitive sense in less overall consumer protection, has got to be fitted adequately into the pattern of an informed public opinion. The questions of retail price maintenance and monopolistic practices have been much in the public eye in recent times, but clearly some basis will have to be worked out in these contentious fields if a reliable enough forecast is to be provided to justify the expensive equipment which goes to make automation.

These larger combinations must also impose on both capital and labour the responsibility for the utmost restraint and sense of public duty in the operation of such equipment. Their power to start or stop such sources of public need must be exercised

with the utmost sense of responsibility and such production units must be viewed as national assets and not merely sectional ones.

Adequate supply of specialists

In this narrow field, then, we have to ensure the adequate supply of trained scientists and technicians to implement the discoveries which can be harnessed to the production need and these people must be provided with the widest possible basis for making decisions. In the technical sense, whilst specialisation is, of course, essential, we must make sure that, basically, training is sufficiently broad in character to enable our engineers wisely to decide the relative advantages of different techniques to secure different ends. To this must be added the development of the right concept in attempting to meet the public need. We must increasingly remember that the aim of production is to satisfy a consumer need and, therefore, increasingly the arts of production must be directed towards satisfying what are true needs and not unnecessary desires. In this sense we must develop the utmost sense of urgency in converting raw materials in the most economic manner. Automation must not only be considered as the means by which the burdens of labour can be lightened in the production field, but it must also be considered the means by which a given amount of material can be converted to a great quantity of useful ends. This is by no means an unimportant aspect. Indeed, in the very nature of things, due to the certainty of a process and the elimination of the human element, one would expect a reduction in direct spoilage. Apart from this, however, as the elements of control become refined and as quality becomes more and more automatically modulated in the process itself, so should the low limit of previous acceptability be more nearly approached by the mean of performance and this should inevitably mean that in many cases the high limit can be lowered with consequent savings in raw materials. From the point of view of the public we must clearly distinguish between function and fashion and see that the variety, which is properly required to meet legitimate changes of fashion and give colour to life, is not allowed to interfere with the much more fundamental considerations of function. Thus, the designers must work towards the end of clothing effective and fairly static designs of function with the more easily changed superficial clothes of fashion. Automation must not be allowed to become so inflexible that the legitimate requirements of both these aspects cannot be provided without radical and capital wasting changes. In this whole field lies the essence of the need for consultation and confidence between all the interested parties and these must include the many different interested parties concerned with producing, as well as those concerned with consuming.

It is often feared that automation techniques lead to redundancy and unemployment. Experience in those industries which are already most automatic confirm the view that in the long run the encouragement of demand by lower cost has, in fact, created employment and indeed whole industries. I have heard it said that at the time of the fundamental change of approach to newspaper production, many men left the printing industry because they feared that with such labour-saving devices it could hold no future for them. We know what future it has, in fact, had. The same, of course, is true of the motor car industry all over the world. We must get away from the atmosphere of conflict and develop the climate of co-operation.

On the national scale the economic considerations are vastly more complicated. Over the period of the industrial revolution we have not only seen immense changes in technique, but we have also seen a very large increase in population and a very great raising of the general level of the standard of living. In the early days of the industrial revolution, the disciples of *laissez-faire* believed that self-interest in this field would ultimately lead to the provision of the goods and services most needed by the community in the most efficient manner, and whilst it was assumed that certain self disciplines would be imposed in order to create a climate of co-operation, in the main it was believed that the less interference given to those practising the new principles of production, the more speedy would be the progress.

It must, of course, be admitted that quite early in this period the public, by way of public-spirited bodies and their elected representatives, took a hand with a view to softening the harsher aspects of this way of life. There is ample evidence of this tendency in the continuous and progressive creation of a public conscience in regard to matters of health and sanitary conditions of living, conditions of working, safety in industry, hospitalisation, education and so on, quite apart from the protection of those in greatest need by many forms of national insurance.

New forms of discipline

All this has, of course, meant that the majority of the individual sanctions have disappeared. It is no longer a case of the survival of basic fitness, it is no longer a case of the uninhibited operation of the law of supply and demand, or the principle of hire and fire. Indeed, with unemployment running at something of the order of under 1% of the working population, with the so-called welfare state and with the wealth of almost undreamed luxuries, completely new personal and corporate disciplines have got to be worked out.

When we consider that in this country, out of a working population of some 23 millions there will be less than 9 millions engaged in manufacture as a whole, we see that the power of production by a limited part of the population must provide the well-being for the whole community, so that the level of material benefit may be general.

When we consider the economic aspect of automation in the national sense, it is immediately apparent from a study of the distribution of manpower that, while increased mechanisation may be applied over pretty well the whole field of the working population, the second power of mechanisation, as I have called it, is only likely to be applied to those products where

there can be a concentration of reasonably consistent or large demand and, accordingly, it may well be that in its fullest sense it is likely to affect a good deal less than 10% of the working population.

If, out of 23 millions of working population, 9 millions are engaged in manufacture generally, it may well be that no more than some two millions will be affected by a big step forward in automation.

The power of this number so engaged would, however, be tremendous, but obviously the advantages must be national and not sectional. Accordingly, it is important that the disciplines which must replace those inherent in the old personal sanctions must have regard to the fact that those two millions have a very large responsibility to the rest of the community.

Passing now to the international aspect, this country can no longer look for its prosperity in the field of cotton, wool and coal. Indeed, as the industrialisation of some backward countries proceeds, this country can less and less depend for its future on the production of exportable consumer goods. It must proceed from the position it was said to hold of being the workshop of the world, to the position of being one of the most important tool rooms of the world and to do this it must not only adopt all the practices of automation for its own production of consumer goods, but it must develop those techniques as an exportable commodity, so that as larger parts of the more backward nations try to satisfy their internal demand by internal industrialisation, they will be able to obtain the equipment, the operating brains and the experience from nations like ourselves.

Economy in material conversion

I have also already mentioned the necessity for the utmost economy in the conversion of materials. In the international sphere this is even more important than in the national sphere. Indeed, it may well be decisive. When we consider that the study of present world resources has shown that something like 95% of the world's important resources—coal, oil, rubber, tin, etc.—are consumed by the industrialised nations, we must expect that as the more backward nations pursue their own desires for industrialisation, not only will all the available material have a much more heavy call upon it and, therefore, the production of raw materials must go up, but the securing of the sort of share which nations like our own have hitherto had is going to be under conditions of very much increased competition. This must inevitably mean that we have to give more for the indispensable materials we need. This must mean that the present pattern, which leads to a balance of payments between trading nations, will change. It will mean that as the backward nations tend to supply themselves with their own consumer needs, we must provide a service where the content of material is extremely low and the content of ability is extremely high.

This development of self-discipline places heavy responsibilities not only on those whose duty it is to invent, devise and lead in industrial matters, but also upon those who must provide the leadership to the operators of industry, whether they be concerned with actual labouring operations or whether they are concerned with the indirect aspects of management which will increase with automation.

A profound influence

On a purely personal basis I have already indicated that even a large increase in the application of automation techniques will still only affect the work of a small part of the working population. The effect will, however, be profound. As the automation techniques of mechanisation, flow, and control extend, so there will be fewer persons required for the purely laborious tasks of production and, accordingly, the working population in automated industries will require to be people specially trained in the indirect techniques of management in connection with accounting, costing, planning, servicing and so on.

We have seen the Government White Paper on the subject of technical education and, of course, this increase of facilities is mostly directed towards the field of industry which we are considering. If this country is to maintain its own level of standard of living, it has not only got to have the automation which is necessary to produce its own consumer goods, but it has also got to have an automation industry in which it can train the right people to take part in what must become a great exporting industry.

The proposals made go a long way towards narrowing the gap between ourselves and other countries advancing at a very high rate, but perhaps the most satisfactory feature is that, apart from attempting to meet the technical requirements, it has been made quite clear that greater emphasis needs to be laid on the wider aspects of education, such as English, accountancy, costing, salesmanship and foreign languages. We need, of course, to strengthen those in the scientific and technical work to maintain the level of basic research and development. Still more, we need an ample supply of men trained to apply the findings of research. Specialisation may eventually be essential, but we must train on the broadest possible basis, so that the utmost flexibility may be retained in applying new or modified discoveries.

First-class opportunity must be available for the study of all the different techniques, but, above all, our young men must be trained to have tidy minds, to be critical and logical, and to be able clearly to express their thoughts and conclusions.

Beyond this there needs to be a deep understanding of general principles, particularly those in which anybody must share who is going to enjoy a true and full life. It may well be that we must bring more philosophy to our work and realise that monotony is in the nature of most things done by most people, and that the contribution we make is a contribution to the general good; that our greatest need, apart from the purely functional one of earning a living, is to develop those characteristics which will enable us to enjoy living. This must mean not only that we must educate those who can study, devise and create automation applications, not only people with the skills to keep this process in continuous operation,

(*concluded on page* 770)

TOOLING
for
PRECISION PRESSWORK

by J. Galway

A Paper presented to the Midlands Region Tooling Conference, 22nd May, 1957.

WHAT are the problems of tomorrow's tooling? From every side we are beset with the cry of greater productivity. The threat of a common European market means that we are faced with ever-increasing competition from abroad and yet in face of this competition we are told " we must increase exports "; and what is the single item which mainly governs the price of our presswork products? The answer is simple—the price of labour—and that price is rising, as we all know only too well. The problem for tomorrow then, is this : — we must increase the production per unit of labour. A very easy thing to say, but of course there are problems in carrying it out. I hope, however, in this Paper, to show how this can and has been done, and to indicate along which lines our future lies in this field.

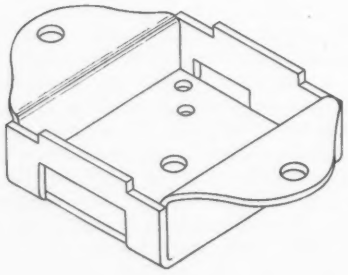


Fig. 1. Small lock case — a pressing made from 0.065" steel

Let me start with a concrete example. A small lock case with which you are all familiar is shown in Figure 1—a pressing made from .065" steel. It carries holes for the lock tongue to work in, holes for various location pins to hold the levers, etc., and two holes for fixing. Its depth is important because, with the cover on, there must be the correct size to accommodate the working parts. In order to produce 100 of these cases, six shillings had to be paid to labour. It is now being produced at a labour cost of six shillings per 1,500, that is, at one-fifteenth of the cost. Surely this is the direction of our future. And this is no isolated case—it applies to a tremendous range of products in many fields wherever a high production is required.

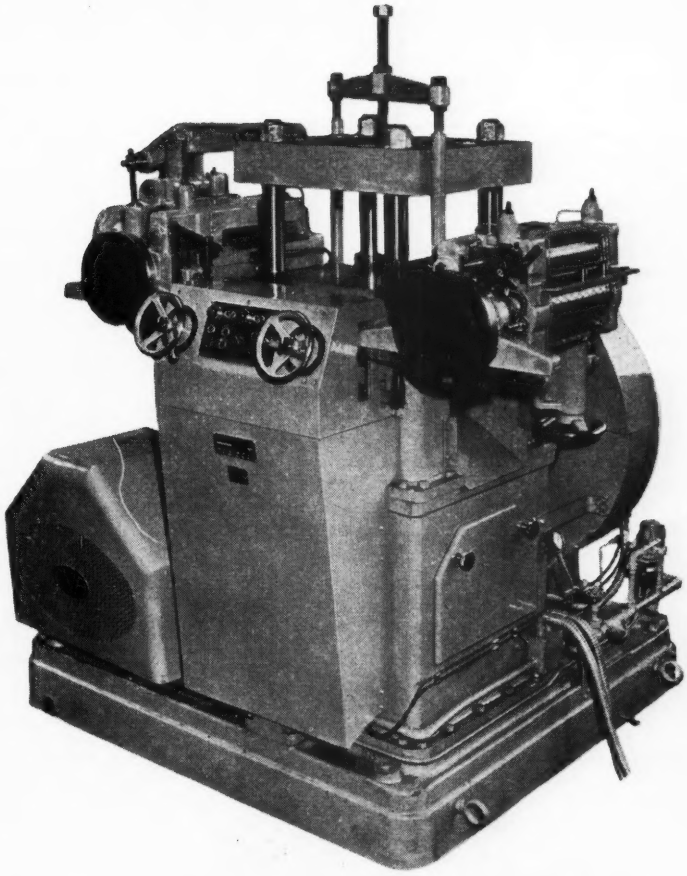
Multi-stage tooling

The method used is multi-stage tooling. The idea of multi-stage tooling is not new, and there are a number of progressive firms where it is regarded as " tooling of today," but you will agree that there are an even greater number of firms where it is definitely an idea for tomorrow, Unfortunately in many cases tomorrow never comes.

This latter attitude of mind is due to a number of reasons, some based on fact, others on prejudice.

A great deal of this resistance to " Tooling of the Future," for that is what multi-stage tooling definitely is, comes from the man in the shop, the toolmaker, press setter, and press shop foreman ; in other words the man who must *handle* the tools, service them, get them working, and maintain his department's output.

Fig. 2. The dieing press



Let's face it, the earlier follow-on tools left a lot to be desired in all the above phases, and the prejudice of the shop man is very often founded upon an unhappy experience of being left with a "designer's dream" and output requirements "as long as Livery Street."

The object of this Paper is to place before you, not opinions, but evidence that multi-stage tooling has been developed to give industry the fast and economic production of precision pressings, that is required now more than ever before.

The tooling set-ups to be described represent, not just automation, but established automation based on the experience of years of development in multi-stage tool design, and the resulting economics are tangible savings and the aim of every production engineer.

Specific examples will be dealt with later on in this Paper, together with the actual results obtained in one of the best known industries of the Midlands, but let us firstly consider the requirements of the tooling.

While no one will question the fact that the conventionally designed press is excellent in its particular field and has served the industry most faithfully for a great number of years, it has certain limitations when it comes to high speed working with complicated multi-stage progression tools. It is for this reason that the dieing press was developed (Figures 2 and 3).

Most multi-stage tools are of necessity long in comparison with their width, and it is essential that an even blow is given over the whole length of the tool. The dieing press, with its long top cross-head,

Mr. Galway was educated at Brighton and Hove Grammar School and Brighton Technical College, where he obtained his Engineering Cadetship Diploma. After three years in the Royal Corps of Signals as a Troop Commander, he joined C.V.A. Jigs Moulds and Tools Ltd., and has now been with this Company for nine years. He has grown up with the development of the progression tool in the Company, via the shop floor, and the design office, and he is now responsible for all tool design and development at the No. 2 Factory.

covers the whole tool, supporting it and distributing the necessary blow exactly where it is required. The die bed is also of equivalent size and has a rectangular aperture in it in order to accept piercings, croppings and blanks from the first and last stages of the tool.

An additional advantage is given by this arrangement, namely, that whereas in an existing design of tool in order to keep the length of tool down several operations have to be done in one stage, they can now be split up into several stages. This reduces the complexity of the original stage and enables the operations to be done in a more correct manner. This reduces also the chances of tool failure and in most cases enables the tool to be operated at higher speeds. I think you will agree that steps in these directions are essentially desirable ones.

When long tool life is required, giving maximum number of parts per regrind, and this is the criterion of this sort of work, it is essential that the punch maintains its alignment with the die and enters it squarely. The construction of the dieing press with its reciprocating lower crosshead, actuating the top crosshead through four substantial pillars, does give this condition of square entry of the punch into the die, and the effect of this has been shown on many occasions with up to three times the die life of previous runs.

Roll feeding

It has been found by experience that for feeding all classes of material, both thick and thin, through all types of tool, both simple and complex, the best method is by roll feeding. Therefore, the press is fitted with input and output roll feeds giving maximum control of the strip, and they are adjustable for varying tool die heights. The relationships of the feed cycle and the roll lift to the press stroke are both individually adjustable. This gives considerable elasticity of press setting to suit the somewhat critical tooling conditions which occur from time to time. Thus it can be arranged, for instance, that the pilots in the tool are just entering the holes in the strip as the rolls begin to open, and are in a position to control the strip as it is freed.

All these conditions, plus an infinitely variable speed motor, add up to a machine designed for the job. It has the dimensional sizes to suit the types of tool, the truly vertical motion of the top platen even under load, the best strip feeding method, and extreme flexibility of setting.

Having considered firstly the qualities required of the press by the tooling, let us consider now, how the tooling uses these facilities.

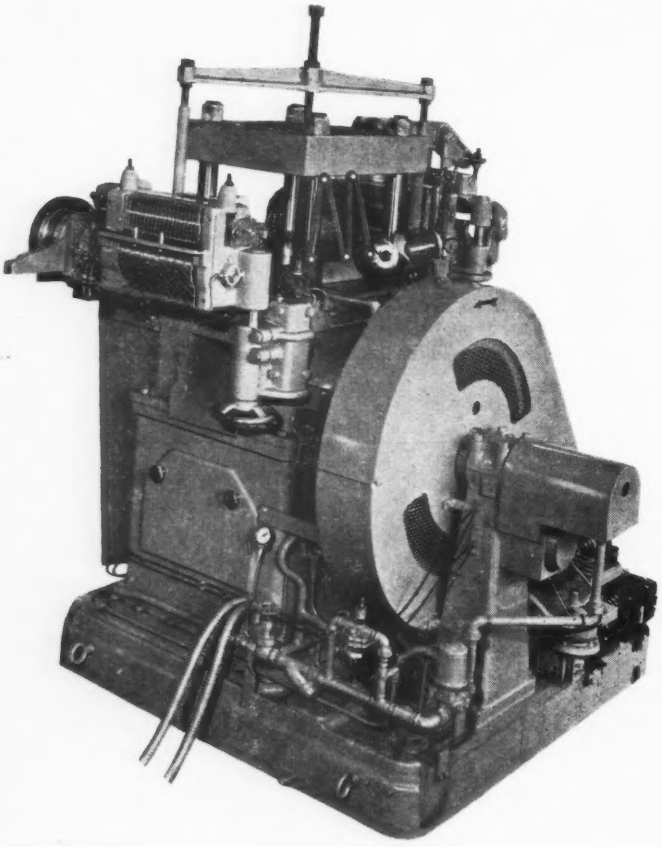


Fig. 3. Another view of the dieing press specially designed for multi-stage tools

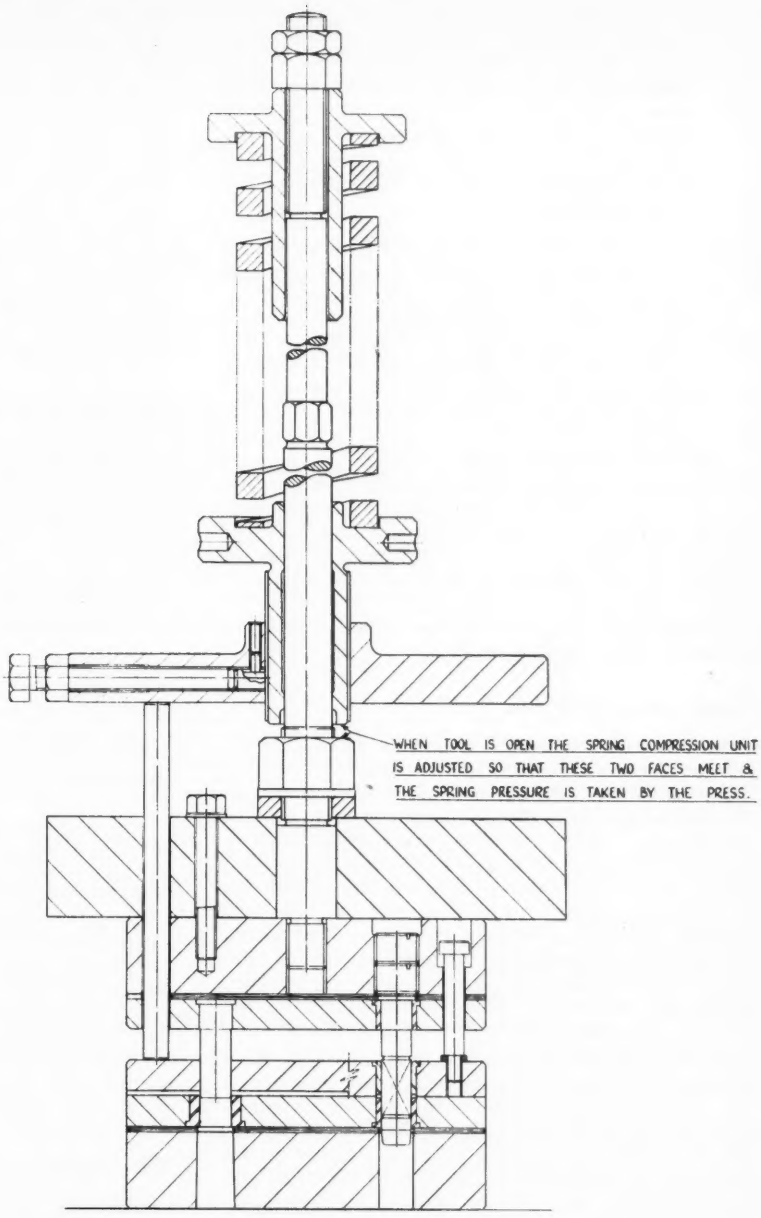

WHEN TOOL IS OPEN THE SPRING COMPRESSION UNIT
IS ADJUSTED SO THAT THESE TWO FACES MEET &
THE SPRING PRESSURE IS TAKEN BY THE PRESS.

Fig. 4. Spring compression unit

There is one basic feature of progression tool design for use in dieing presses which is essential, and that is the spring loaded stripper. This statement is based on several facts which it is as well to have in mind, and they are these :

1. With a spring loaded stripper, the movement of the punches in the stripper is confined to a small amount dependent upon the operations being performed in the tool. For instance, in a pierce and blank tool, such as a lamination tool, the movement is limited to about $\frac{1}{16}$" —in a draw tool the movement is usually just over the depth of the longest draw, and so on. If a fixed stripper is employed, the movement of the punches relative to the stripper is the whole stroke of the press, and in many cases this means that the punches are leaving and entering the stripper at every stroke. Not only must this lead to loss of the cutting edges, but must also give rise to much more friction. When considering high speed working, this means that there must be a greater clearance between the punches and the stripper, thus losing some of the supporting and guiding characteristics of the stripper.

2. If a misfeed occurs with a fixed stripper it usually means that the strip jams up between the stripper and the die, and it takes a considerable time to clear it, as well as in most cases not giving any clue as to why the misfeed occured. With a spring loaded stripper the die face is left clear and open when the strip is feeding forward, and it is much easier to see what is going on.

3. When it is necessary to lift the strip above the working die parts in order to feed it forward, the spring loaded stripper is even more essential. The stripper strips the punches, and then allows the strip lifters to rise and lift the strip clear of the dies. By this means, the stripper controls the level of the strip so that the punches can perform their correct functions.

The normal method of spring loading a stripper is to introduce springs between the stripper and the punch plate. This method, though widely used, has several disadvantages. It is more often than not difficult to find room for the necessary number of springs. It is necessary to overload the stripper in order to ensure positive stripping and to counter the inevitable spring fatigue ; and the springs are subject to failure with, sometimes, drastic results.

Spring compression unit

With the dieing press, it is possible to fit a spring compression unit (Figure 4) which has been specially designed for use with the press, and which gives all the advantages of a spring stripper without any of the disadvantages. The stripper is loaded with one large spring which is capable of stripping any job which will go in the press ; it is infinitely adjustable in its working condition so that only the necessary pressure is applied, and when the tool is open all the spring pressure is taken by the press, and not by the stripper bolts which act purely to stop the stripper falling off. As soon as the stripper contacts the die, however, the full stripping pressure is available.

In tools where slender punches are used, it is essential that they are given maximum support as close to the die as possible. Obviously this support must be given by the stripper, and to effect this, four hardened and ground pillars are fitted in the punch plate, and are made a slide fit in hardened and ground bushes in both the stripper and the die. This makes certain that the three working members of the tool, that is, punch plate, stripper and die, are always in correct alignment. They also serve to line the two halves of the tool up when setting in the press.

This is taken a step further when working with thin material, that, is of the order of say 0.005″. In these cases, the line up of the punch and die is of paramount importance owing to the very small clearance between them, and hardened and ground inserts are fitted into the underside of the stripper which are a close slide fit to the punches. Only by this means is it possible to attain the high degree of accuracy required to give the longest possible tool life per re-grind, which in these cases is entirely dependent on the correct entry of the punch into the die.

In larger tools, where the punches are much sturdier and can maintain their own alignment and will not be influenced by the stripper, it is not *necessary* to guide the stripper in this way. Thus the tool is built into a 4-pillar die set of conventional type. This die set is usually of special make, however, to ensure that the tool can be entered between the pillars of the press. With this type of tool, which is usually of the heavier variety, the " ball bearing " type of pillar and bush is used in order to give easy running and to help considerably with tool construction and maintenance.

Two general systems

There are two general systems of building in the punches and dies ; that is, by the insert method, and by the individual stage method. The systems can be used on their own or together as required.

In the first system, which is usually applicable to the smaller type of tool, the die is built up of one, two or three plates into which are fitted inserts for the various stages or groups of stages.

In the stages where piercing, shearing or blanking takes place and which will need regrinding, the hardened inserts are made a press fit into the chase. They are held in the chase either by flanges or, where there is sufficient room, by screws from underneath. Where accuracy is required, and especially where thin material is being worked, these inserts are split up so that they can be ground all over, including the correct amount of back off. Owing to the length of tool which it is possible to have, the piercings can be arranged in a number of stages so that there is ample die strength between adjacent apertures, so lessening the risk of die failure. If a die should chip, however, it is only a small part which has to be replaced. Where thick material is being worked or where the accuracy is not so important the dies can be made from the solid, and are either inserted in the same way, or can be made to spread right across the tool depending, of course, on the tool conditions.

The forming stages

The forming stages can be constructed in two ways. If there are, say, only two such stages, the two forming blocks are inserted into the same chase that holds the cutting dies. They go right through the chase and are invariably held in position by a screw from underneath. They are made with parallel sides and are a light press fit in the chase, so that they can be easily removed without disturbing the rest of the die. Where there are a series of forming stages, for instance in a six-stage drawing tool, the forming or drawing inserts are housed in a separate chase of their own. They are either let part way into the chase and screwed from underneath the chase, or made press fit into it and held by deep flanges.

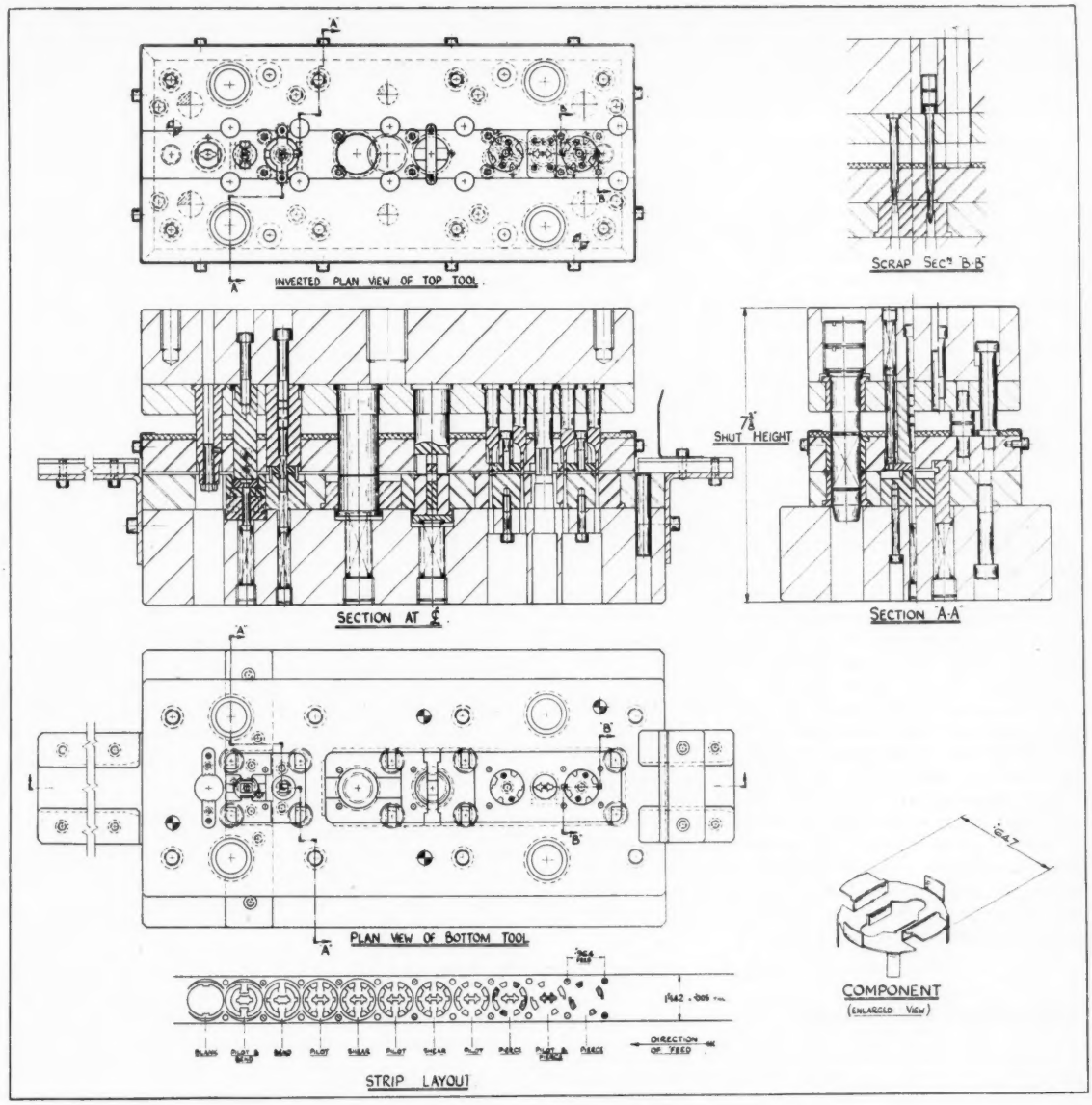


Fig. 5. Tool for producing a radio valve shield (bottom right) in 0.005" thick nickel plated steel

The important principle behind all this is that on regrinding, the forming insert in the first case, and the whole plate carrying the series of inserts in the second case, are removed from the die. It is then possible to regrind the cutting edges as with a straightforward pierce and blank tool. The forming stages are then inverted and an equal amount taken off the underside. Thus, on reassembly of the tool, the overall die height is maintained and the forming stages have not been disturbed. Once these forming stages have been established they need never be touched. This is a very simple procedure, but can save endless hours of tool maintenance.

The construction of the top tool is made on the same principle, namely, that every punch which does not have to be sharpened is screwed back from the top bolster. On regrinding, the same amount that is taken off the cutting punches is taken off the back of the forming punches. The piercing punches are either flanged in the punch plate or in the case of larger punches are made with a thick flange, and are individually positioned and screwed and dowelled

in that position. This latter method is often preferable to inserting into a punch plate, giving more flexibility for the tool maker in construction, but the governing factor is usually the size of the punch and the number of punches in close proximity to it.

Another feature of design which helps considerably, in the case of maintenance, is the construction of the pilots and the guide pillars. The guide pillars are always held in position by grub screws in the top bolster, and the pilots are either held solid by grub screws when working thin material, or made spring loaded for thicker material. Thus when the top tool is reground the grub screws can be removed and the pilots and pillars let back, so that the grinding wheel has a free run over the punches.

These principles of construction for regrinding and maintenance facilities, as just described, apply equally as well to the second general system of tool build up.

In this system, which is applicable usually only to the larger type of tool, the whole tool consists of a top and bottom bolster which house a series of individual tools. These individual tools can be either one for each stage or as convenient for each group of stages. The tools consist of essentially the elements as previously mentioned, that is, punch plate stripper and die, in many cases pillared together, and are constructed also as previously described. Spare units can be made which are interchangeable with those in the tool, and thus when one unit needs maintenance it can be replaced by a fresh one to maintain production. This system can also be used when a common component is being produced which has a series of, say, different cut-outs in it, as with a lock case with different keyhole slots in it. Here the keyhole piercing sections can be made as separate tools all interchangeable within the main tool, and they can be put in and taken out of the tool whilst it is still in the press to give continuous production of the various parts.

Application of basic principles

So far, we have covered the general principles of design and construction with a view to maintenance and all that it implies. It would be impossible to cover, in the time available here, a description of all the details which are involved in the preparation of strip layouts and subsequent design to suit the tremendous range of parts which are ideally produced in the progression tool. Consequently I propose to examine three designs of tools involving different components, to show how these principles are applied in practice. I would emphasise however that these principles are basic ones and form the foundation on which successful tools are designed and built.

The first tool (Figure 5) is one to produce a shield for assembly in a radio valve, and is produced from 0.005″ thick nickel plated steel at one per blow on a 25-ton dieing machine.

This tool is built on the principle of the punch plate, stripper and die being pillared together, and has three distinct sections.

The first section consists of the piercing and shearing stages necessary to make the shape of the part, and to release it for subsequent forming. The second section caters for the forming of the part in two stages, and the last section is the cutting off or blanking stage.

The piercing stages are three in number and are built into jig ground holes in a hardened block. The inserts in the first and third stages are round, and have the forms form ground into the periphery, and are screwed and dowelled in position. The second stage is a split bush which is again form ground.

The shearing sections are built up in a similar way. In the first of these stages, the four legs are released by shearing, and four slits made in the component for subsequent forming. In the second of these stages, the component is partially released from the strip by shearing round the outside in order that the forming of the component will not deform the carrying web of the strip and cause any loss in progression or pitch.

First forming stage

The first of the forming stages bends down the four legs previously sheared from the strip and the two legs in the centre. In the top tool is a spring loaded pad which holds the component before bending in the approved way, and the whole punch assembly becomes solid at the bottom of the stroke to flatten it.

In the second forming stage the component is held between the punch and a spring loaded pad in the die, and is pushed down into the die, bending up the remaining forms.

The forming is now complete and the component is blanked out, the two cutting edges being made by small inserts in the face of the die chase. These die faces are parallel for $\frac{3}{16}$″ and then stepped back by $\frac{1}{64}$″. The punch enters the die for more than $\frac{3}{16}$″ so that on the up stroke the component is stripped from the punch by the die and falls free. This avoids a succession of blanks piling up on each other giving distortion of the form.

Built into the corners and along the sides of the inserts are spring loaded strip lifters. These serve to guide the strip through the tool and to lift it above the die face for feeding forward. They are depressed on the down stroke by the stripper where pockets are provided to leave them at the correct height.

You will note that the underside of the stripper has been built up in the piercing stages in a similar way to the die. This gives good support and location for the punches, as it is essential that on this type of component there are no burrs which give electrical interference in the valve. Thus the punches and dies are made a slide fit which must be maintained. The back-off in this die is 0.0015″ per inch per side. This amount of back-off means that within the grinding life of the die, the die apertures do not

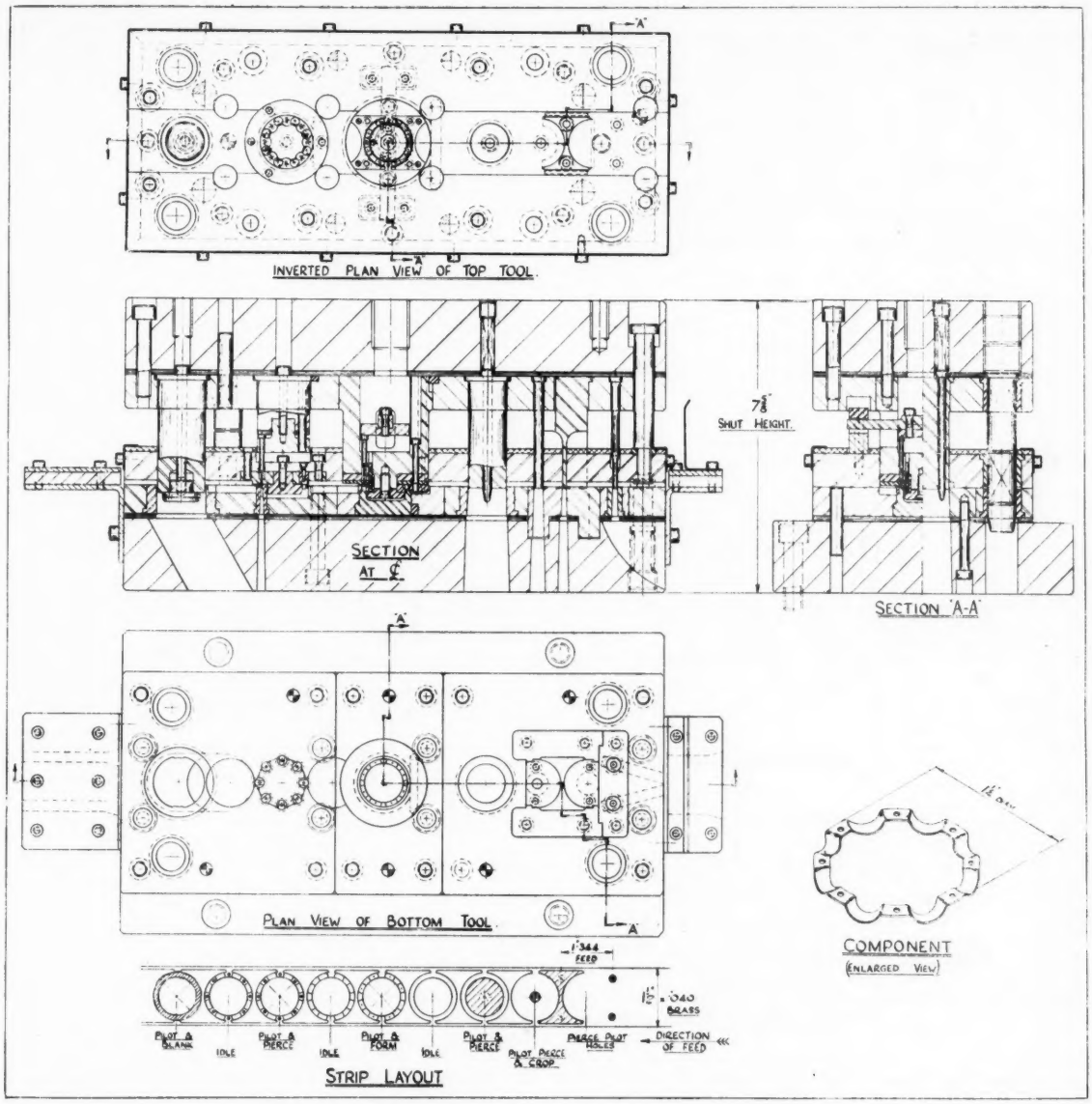


Fig. 6. High precision tool for producing ball race cages (bottom right) from medium thickness brass

grow in size sufficiently to cause burrs due to too much clearance, or allow the slugs to pull back on to the die face.

This tool has been tested to run at 250 strokes per minute or a production of 15,000 per hour. In production it is run at something less than this, which is found to be the most economical speed.

The second tool (Figure 6) is an example of a high precision tool to produce ball race cages from medium thickness brass. They are produced at one per blow from 0.040″ thick material. The tolerances on this particular part are, as you can imagine, very tight, especially the pitch of the rivet holes. The test for these holes is to stack a dozen or so cages one on top of each other without making sure that they all came off the press the same way, and then a 0.002″ undersize pin must pass easily through all the holes in line. This gives some indication of the accuracy required and given.

The strip is pierced in the first two stages, leaving the cage tied to the strip in two places, corresponding to where two flats will be.

The cage is formed in one operation and then pierced in the subsequent working stage. It is blanked

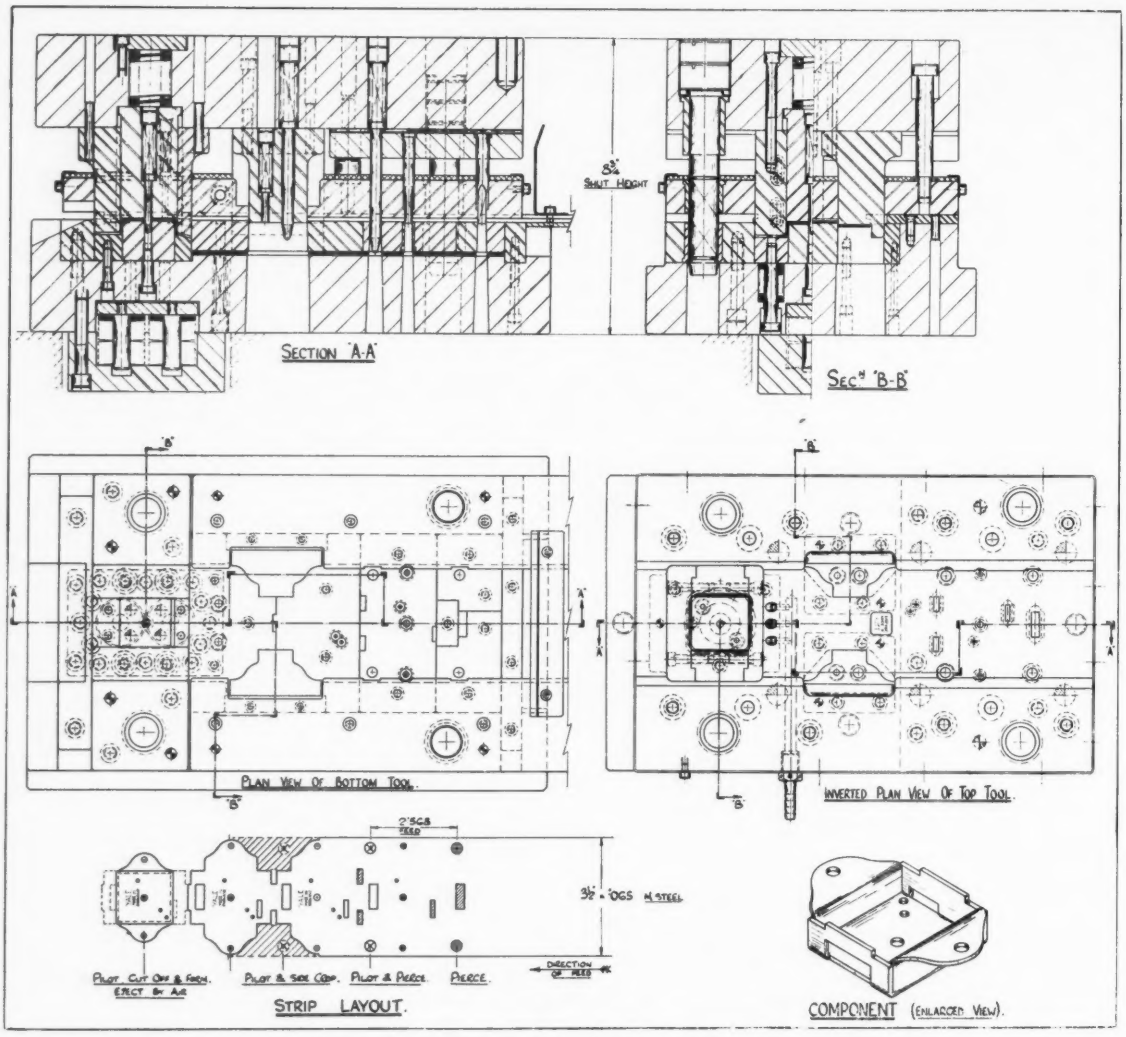


Fig. 7. Tooling for the lock case shown in Fig. 1

out in the final stage. The piercing stages are built up of inserts in a die chase as previously described.

The forming is done by a series of flatted balls in the punch, located in holes in a disc and held in position by an internal and external ring. The gap between these rings just admits the cage, and the centre ring acts as a pilot for location. The die has the corresponding recesses in it which are accurately ground. After forming, the cage is stripped from the punch by four push-off pins actuated from the main stripper.

In the piercing stage the cage is located by domed pins in a stripper insert, this same insert carrying holes to guide the piercing punches. The punches are housed in a separate punch holder for quick replacement. The piercing dies are small " button type " inserts bearing the necessary clearance for the formed parts of the cage.

The blanking die is an inserted ring, cleared away except where it is required to cut.

When regrinding, the whole of the forming section is removed and the necessary amount ground off the underside, with the deep flange and key to accommodate.

The strip lifters in this case are round and the output guide is channelled to accept and control the two separated scrap webs.

This tool has been tested to run at 200 strokes per minute or 12,000 cages per hour. The saving on previous production methods of three operations, pierce and blank, form, and then pierce needs no elaboration.

The third tool (Figure 7) is a heavier type designed to produce the lock cases previously described. The method employed is to pierce all the holes, slots and cut outs and then the case is cut off and formed up

in one operation and ejected from the die face by an air blast. The strip is scrapless and is fed only by the input roll of a 50-ton dieing press.

The piercing and cropping stages in the die are built up of hardened and ground inserts which are let into a slot in the bolster of the tool. They are let in for their full depth, so that the side guides can be screwed and dowelled to the soft bolster, and not to the die steels. In the first stage, two large holes are pierced in either side of the strip for piloting the next stage. These holes are in the scrap which is cropped out at the third stage. The inclusion of these holes ensures good location of the strip right from the beginning. The component holes are pierced in die buttons let into the hard steels. This gives a servicing facility if any damage occurs, and also enables correction of hardening distortion by jig grinding to be carried out.

The final stage of the tool completes the component. In this particular application, there is nothing to gain by splitting the forming into two operations as it would only complicate the tool. The stage not only forms the two ends and the two sides, but also planishes the sides at the bottom of the press stroke in order to maintain the correct depth for the assembly of the working parts of lock. The method used is to do the initial bending over a pommel which is spring loaded sufficiently to take the bend without deflection. Then, as the top tool becomes solid the pommel is deflected down, and the sides come into contact with planishing blocks to set the correct form.

To get sufficient sprung pressure under the pommel, "Belleville" spring washers were used, built into packs and giving a deflection of about 0.040" which was sufficient for the purpose.

The air ejection is put into the stripper so that it provides a blast of air in the right place at the right moment.

The two large cropping punches are screwed and dowelled separately to the top bolster as previously described. They carry pilots to register in the two pilot holes and push-off pins to ensure that the pilots do not tend to pull the cropping back onto the die face.

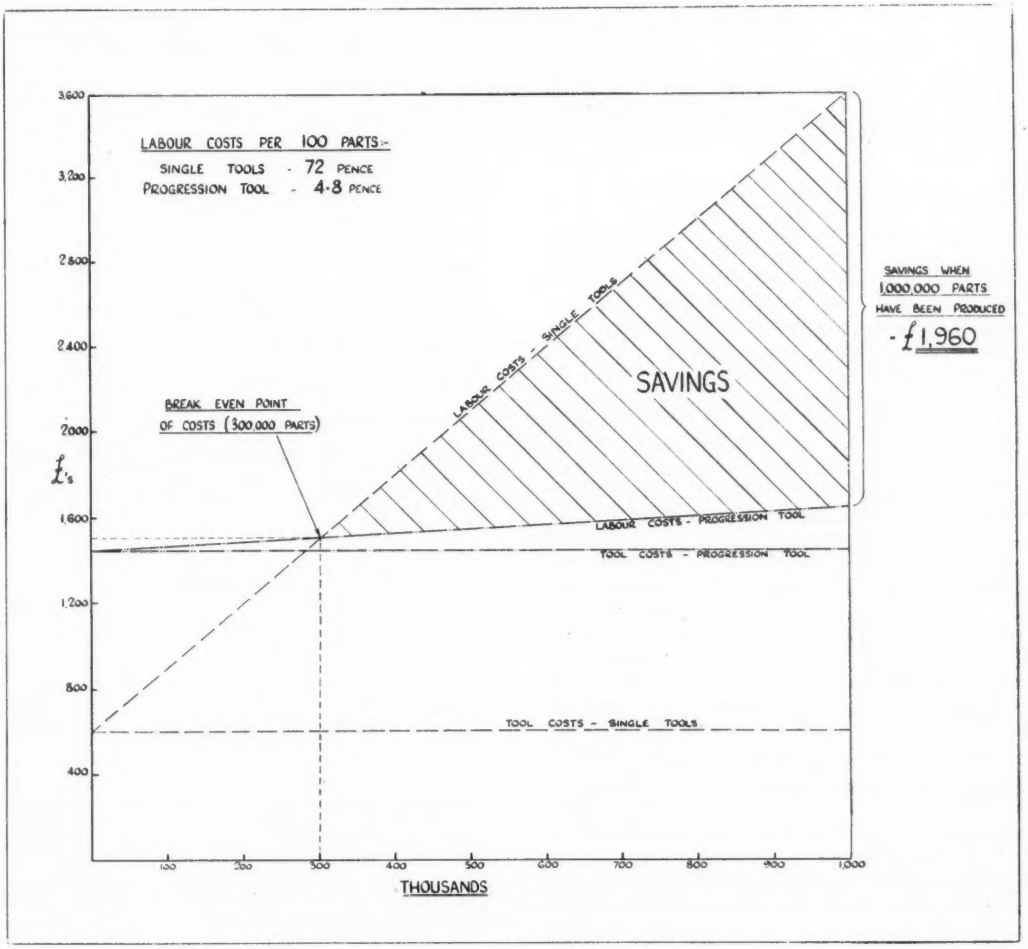


Fig. 8. This chart shows the economics of the lock case tool

The forming punch assembly is also positioned separately and is built up as a box round the central spring loaded pressure pad. This pad contains the pilot for locating the component, and also push off pins to ensure the ejection of the finished case.

The same principles regarding regrinding facilities and general construction are applied in the same way as before.

The production obtained with this tool is approximately 140 lock cases per minute or 8,400 per hour. The previous method of production was by single tools on separate presses with the associated hand loading. The chart in Figure 8 has been prepared to show the economics of this particular tool and it concerns only the original tool costs and labour costs. The original single tool costs are estimated at approximately £600 and the labour costs are estimated at approximately £300 per 100,000 cases. The progression tool costs were £1,430 and the labour costs now are £20 per 100,000. With these total cost lines plotted on the same graph, the cross-over point indicates the production at which the methods break even, which in this case is at 300,000 parts. After this point the saving is of the order of £280 per 100,000 parts. Thus, at this rate, after producing 1,000,000 parts, the saving is of the order of £1,960 !

What then is the conclusion to be drawn from these facts ? I would emphasise again that I have dealt with practical and established facts and not theories.

It is this ! Here is one answer to the challenge to increase productivity. It is a method which has been, and to a certain extent still is, hidebound by prejudice and bad practice. It is a method which is capable of showing great economies and whose line of approach has now been successfully developed. It is along this line that we must proceed to our tooling of tomorrow.

SOME ASPECTS OF AUTOMATION —

concluded from page 759

but also people who, having a sense of vocation, will perform their duty in the period set aside for labour in order to enjoy with the community the period set aside for leisure.

Herein lies the essential discipline which has to be developed to replace the disciplines which were inherent in the sanctions which we associated with past days. The operation of *laissez-faire* brought cause and effect so close together that the penalty for given action was immediate and obvious. The normal operation of the economic law of supply and demand, whilst allowed freely to operate, was obvious and immediate, but with the increasing complexity of production, the increasing size of producing organisations, with the element of Government control, to avoid large swings in the well-being of the nation, the immediate character of result from a cause becomes blurred. We must be led to impose a self-discipline which will be dictated by the same sense of ultimate well-being, but based on a more certain knowledge of our personal responsibilities in the well-being of the community. Thus, to practise the principles of automation, we must realise that whatever well-being may result has got to be spread over the nation or community as a whole and has got to cover not only the rest of the less mechanised working population, but also the non-working population of the young and the old.

By developing such sense of responsibility, we shall recognise our gifts as opportunities and our opportunities as obligations. If, by the extension of these principles, we can not only maintain the standard of living of our own community, but can contribute to the raising of that standard in the so-called backward countries of the world, we may hope to arrive at the time when the material needs of mankind shall be sufficiently satisfied as to enable him more fully to explore his spiritual and aesthetic aspirations.

RESEARCH PUBLICATIONS

The Institution is advised by PERA that Dr. G. Schlesinger's book on " Accuracy in Machine Tools : How to Measure and Maintain It " is now out of print and cannot, therefore, be supplied. The following I.Prod.E. publications are, however, still obtainable from PERA at " Staveley Lodge ", Melton Mowbray, Leicestershire.

" Practical Drilling Tests " by D. F. Galloway and I. S. Morton. Price 21s.

" Machine Tool Research and Development " by D. F. Galloway. Price 10s. 6d.

JOURNAL BINDERS

Strongly-made binders for the Institution Journal, each holding 12 issues, may be obtained from Head Office, 10 Chesterfield Street, London, W.1. price 10/6 each, including postage.

Measuring and forecasting cost data in highly variable production

by A. G. Thompson, B.Sc., A.M.I.C.E.

a statistical and analytical technique illustrated by reference to arc welding

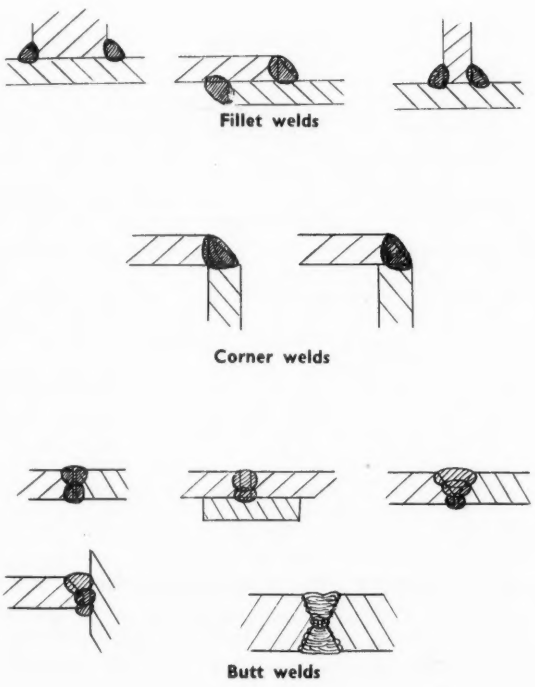


Fig. 1. Types of arc welds

THE purpose of this Paper is to describe a statistical and analytical approach to measuring and forecasting cost data as opposed, for example, to the synthetic approach of element time study. The need for a new method is shown to arise when highly variable, small quantity production is considered and where standardisation of the job in many respects is impossible. Such fields include much of the heavy plate and structural fabrication industries including shipbuilding, and the civil and building industries.

The principles and methods are illustrated here by the work of making welds by manual arc welding and also by the fabrication of welded stiffened plate production.

The implications for productivity measurement of highly variable production

An example of highly variable production

The main types of weld in general use are illustrated in Figure 1. The work of making the weld depends very much on the weld volume, which is highly variable, and also is a quantity that cannot readily be standardised.

To illustrate this point, the results of a number of time studies of the welding of some 80 vertical shell butts on a ship are shown in Figure 2, where weld volume is plotted against weld size. Each butt weld took over 2 hours to complete. The range of volumes for nominally identical plate thicknesses and joint dimensions is seen to be as much as 100%. Some causes of weld volume variation are illustrated in Figure 3.

There is great opportunity for error if the volumes of these shell butts were estimated from formulae or from laboratory tests where the joint fit would be perfect. Conditions would be assumed entirely different from those occurring in production. Therefore, the values obtained by theory or laboratory tests would most probably be incorrect.

Authorities on the subject do not agree on what the volume of a given weld should be. Values of

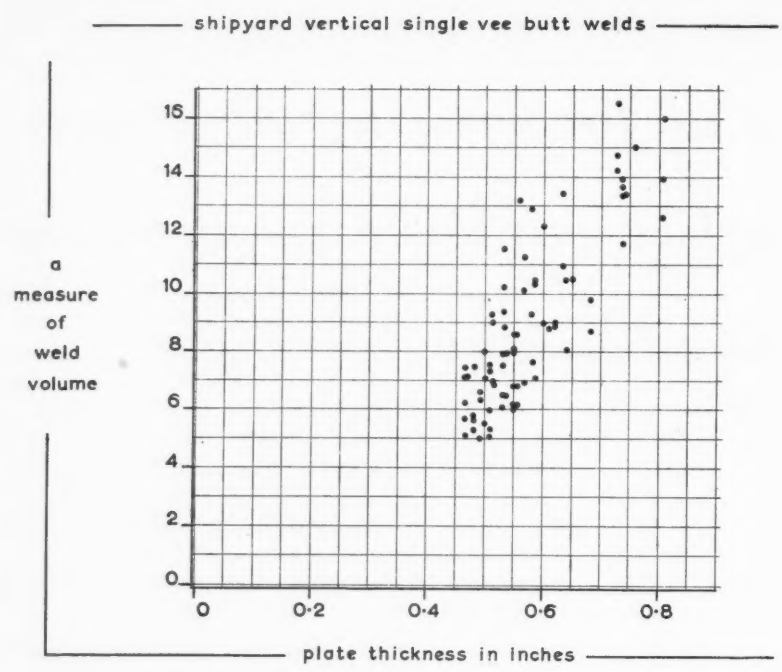


Fig. 2. Weld volume per foot of joint plotted against average plate thickness

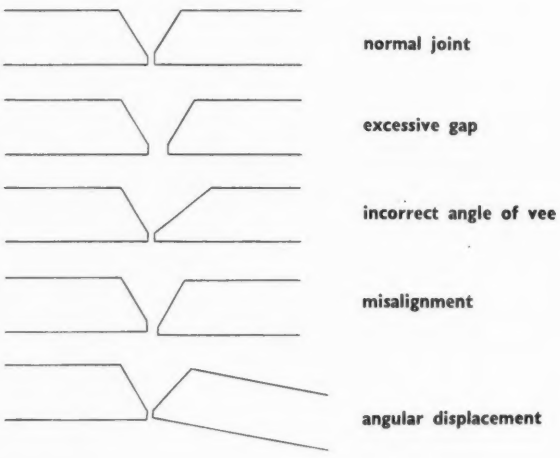


Fig. 3 (right). Some causes of weld volume variation

area of half inch single vee butt weld
flat position (in square inches)

theory
- kerr ..... 0·141
- kielb ..... 0·176
- cergna ..... 0·197
- braithwaite ..... 0·204
- jacobsen ..... 0·229

laboratory test
- kerr ..... 0·15

Fig. 4 (left). Weld volume as proposed by various authorities

weld volumes for $\frac{1}{2}$" single V butt welds (Figure 4), and $\frac{1}{4}$" fillet welds (Figure 5) quoted by authorities vary by about $\pm$ 25% of the mean.

Butt and corner weld volumes are largely outside the control of the welder and are presented to him as a joint shape which he has to fill with weld metal. A fillet weld, on the other hand, has a volume which depends not only on the joint fit and squareness, etc. but also on the welder himself. For fillet welds, where good fit and squareness can be guaranteed, and this does not appear to be difficult to achieve, a given size of weld should have a "standard" volume, wherever it is made. For butt and corner welds, however, the weld volume is a function largely of plate preparation and assembly accuracy. It cannot, therefore, be standardised on a national basis, but depends on the facilities and methods of a given works.

The variability which has been illustrated by reference to butt weld volume is repeated in varying amounts for many other factors affecting the arc welding process. It is therefore apparent that there is great danger in using cost data which have not been obtained from actual production. Further, the large variability has consequences with regard to the way data are measured, presented for use, and used.

The accuracy of a forecast in highly variable production — tolerance and confidence

Consider a large number of *nominally* identical butt welds where large variations in the weld volumes may occur as in Figure 2. Let the mean time of all production to complete the weld be, say, 50 minutes per foot, while individual values vary in extreme cases from 30 minutes per foot to 70 minutes per foot. It would be possible to say that a certain percentage of the production have values which lie within certain limits and this is one way of describing the variations of the production. For example (Figure 6), let 95% of the production have values in the range between 40 minutes per foot and 60 minutes per foot. It follows that the probability of picking one weld at random from production, having a time not less than 40 minutes per foot and not greater than 60 minutes per foot, would be 95% ; that is, 19 chances out of 20. The range of the limits, such as 40 minutes to 60 minutes in this example, may be regarded as being of the nature of a tolerance which if defined allows an assessment of confidence to be made that any random value may be found to be within that range. In the example above, it might be said that for the tolerance 40 minutes to 60 minutes per foot there exists a 95% confidence. The tolerance may be expressed as a plus or minus percentage of the mean : for example, the tolerance may be expressed as $\pm$ 20% in the example given above.

For a given production, the tolerance and confidence are interrelated. If, for example, the tolerance is widened, then the confidence will increase, while if the tolerance is narrowed, then the confidence will decrease. For example : if the tolerance were widened (Figure 7) to the range 35 minutes to 65 minutes, i.e. $\pm$ 30%, the confidence may increase, say, to 99%, while if the tolerance were narrowed (Figure 8) to 45 minutes to 55 minutes, the confidence may be reduced to, say, 70%. In other words, there would only be one chance in a hundred of being wrong in saying that any individual value would lie within the range 35 minutes to 65 minutes, but there would be one chance in about three of being wrong in saying any individual item would lie within the range 45 minutes to 55 minutes.

Further, if the variability of the production were to increase, the tolerance would have to be widened to maintain a given confidence or, alternatively, the confidence would have to be reduced for a given tolerance.

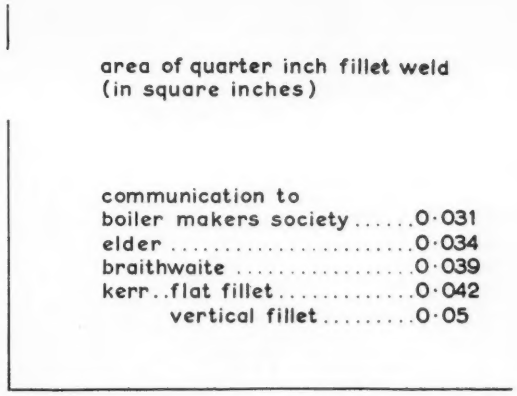


Fig. 5. Weld volume as proposed by various authorities

★

Mr. Thompson is an Industrial Engineering Consultant. He graduated at Birmingham University, and his early experience included research and development work on airborne equipment and some practical civil engineering training.

Later, he became Manager of the Technical Service Department of the Quasi-Arc Co. Ltd., and subsequently Manager of the Constructional Design Department of that Company.

In 1951, he joined an Industrial Consultant and was engaged on investigations into product design and production problems in welded fabrication and, in particular, shipbuilding.

In 1954, Mr. Thompson joined the British Welding Research Association and, as a Principal Officer, was responsible for the work described in this Paper, which he presented to the Birmingham Section of The Institution of Production Engineers on 20th February, 1957.

Mr. Thompson started his present practice earlier this year.

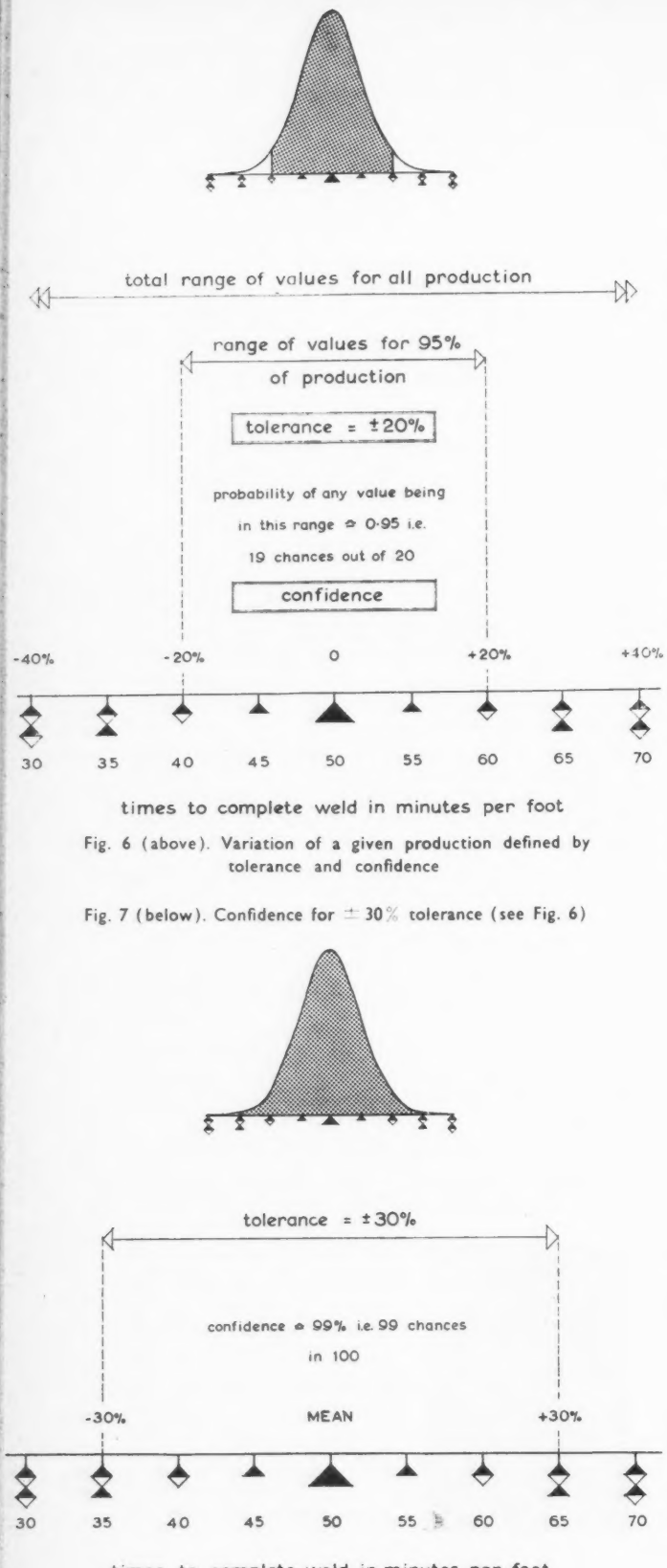


Fig. 6 (above). Variation of a given production defined by tolerance and confidence

Fig. 7 (below). Confidence for ± 30% tolerance (see Fig. 6)

It may be asked how these figures are obtained. It is impossible to measure the time to make every butt weld in a works. Further, this sort of data could not be obtained purely from theoretical calculations or from laboratory tests.

These figures are obtained from samples of production, that is, in the present example, by measuring values for a number of butt welds. The tolerances and confidences are then calculated from these values, using simple formulae based on statistical mathematical theory.

The effect on tolerance and confidence of the size and composition of basic and estimating samples

The tolerances and confidences discussed so far relate to a single item, i.e. a sample of 1. It is not difficult to estimate the confidence of finding the mean of samples of 2, 10, 100, etc. within various limits, i.e. appropriate to various tolerances.

For a given confidence, i.e. 99%, 95% or 67%, etc., the tolerance is reduced as the sample size increases. In the butt weld example, if the sample size is 100 items and the confidence required is 95% (Figure 9), then it should be possible to reduce the tolerance to the order of ± 1 minute, i.e., for samples of 100 items, 95% of the means of such samples should lie within the range of 49 minutes to 51 minutes, or the probability of the mean of such samples being found within the range 49 minutes to 51 minutes is 95%, i.e., 19 chances out of 20.

The methods to be described depend on taking samples and drawing conclusions from them, so that it might be useful to consider in more detail what happens :

1. Production is sampled on one or more occasions, and the output and corresponding time (labour or machine) is measured. The relation between output and time is found for this *basic* sample.
2. It is assumed that for all the production, of which the basic sample is part, the relation is the same as for the basic sample.
3. For other samples, e.g. a cost batch from the production, the output only is measured and the time is estimated from the relation found for the basic sample. In this procedure there is the implied assumption that the relation found for the basic sample applies to the cost batch samples.

For example, suppose, as before, that the mean time per foot of the butt weld for all production is 50 minutes. In actual fact this would not be known but assume for the moment that it is (Figure 10).

Now a sample is taken and the time and output measured for one or more welds and it is found that the time per foot of weld is 53 minutes. This is the figure which will be used for estimating in the future and an error of 3 minutes has been introduced. This sample is called the *basic* sample.

Next, a batch of work is taken for which it is wished to estimate the time, say, the work of one man for a week. This sample is called the *estimating*

sample. Again, it is assumed that the mean time for this batch is known and that it is 48 minutes per foot of weld. It will be estimated as 53 minutes per foot and the error will finally be 5 minutes per foot or 10%.

This error is made up of two components :

(*a*) the error in the basic sample, i.e., that the relationship found for the basic sample differs from that for the whole production, and

(*b*) the error in the estimating or cost batch samples, i.e., that the relationship for these estimating samples differs from that for the whole production.

These are the errors inherent in this type of sampling, and which are defined by the terms tolerance and confidence which have been discussed. In the possibility of being able to estimate these errors and hence the tolerance and confidence, lies one of the advantages of the methods to be described below.

Meanwhile how may these errors be reduced ?

Firstly by increasing sample size—both the size of the basic sample and the estimating sample. This effect is shown in Figure 11. This figure also illustrates the interrelationship between tolerance and confidence and the limiting accuracy of the estimating sample at any number of items due to the basic sample error. It will be seen that as the size of the estimating sample increases, the tolerance of the sample decreases for a given confidence. Alternatively, the confidence increases for a given tolerance. The tolerance for a very large estimating sample tends to become equal to the tolerance of the basic sample.

For an estimate made from knowledge of the production in an estimating sample and based on the relation found for a basic sample, the tolerance will be narrowed and confidence increased by increasing the size of the basic sample and the size of the sample itself. The effect on tolerance and confidence of changes in sample size is most marked for small samples.

Secondly by the composition of the sample. If there is considerable variability in the production caused by differences, such as plate thickness and sizes, it is important that the basic sample should, as far as possible, exhibit a similar pattern of variability in its composition.

Certain relevant characteristics of three broad divisions of engineering production are listed in

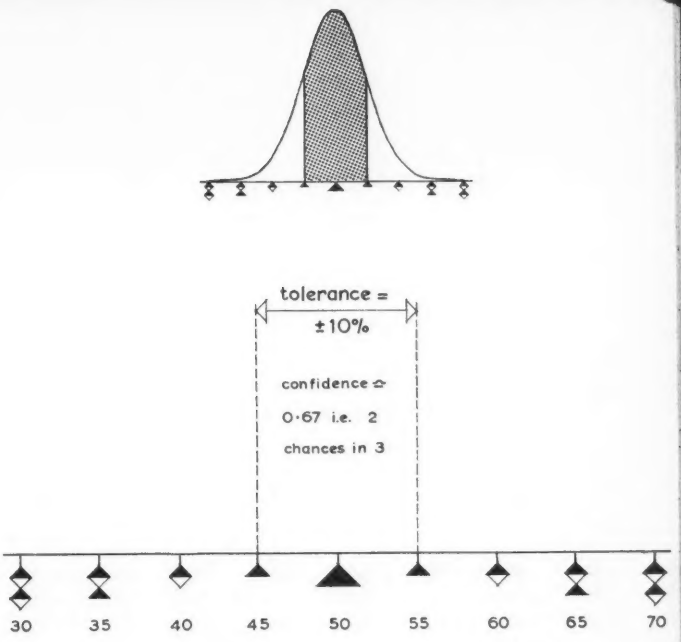


Fig. 8 (top right). Confidence for ± 10% tolerance (see Fig. 6)

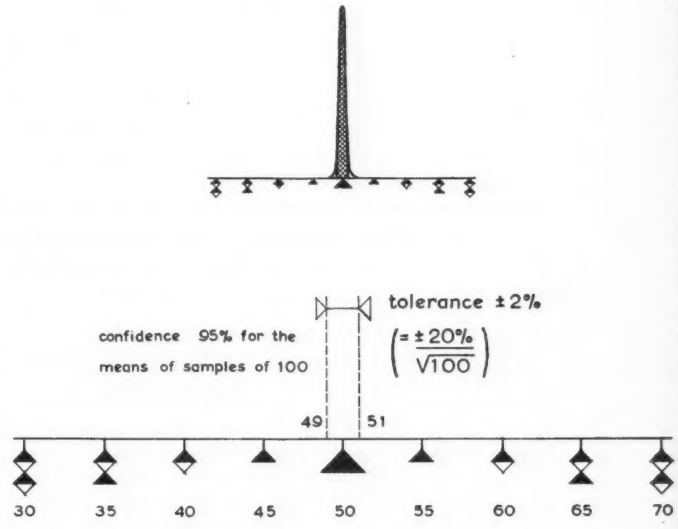


Fig. 9 (centre right). Tolerance and confidence for samples of 100 items

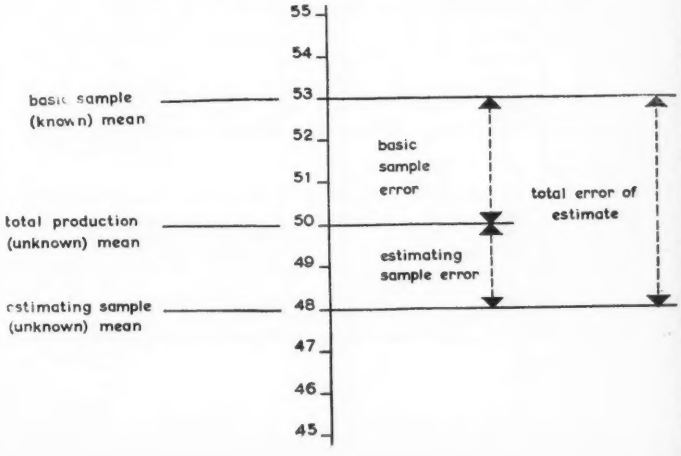


Fig. 10 (bottom right). Sources of error in an estimate

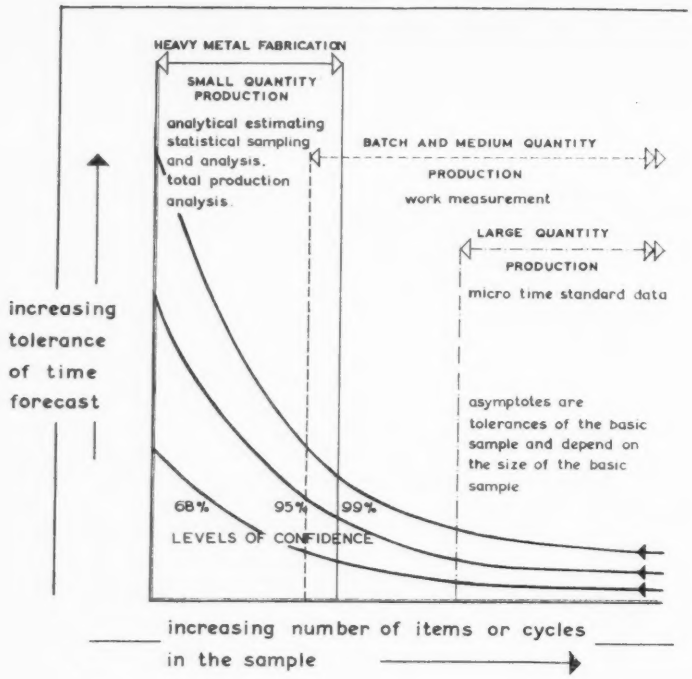

HEAVY METAL FABRICATION
SMALL QUANTITY PRODUCTION
analytical estimating statistical sampling and analysis. total production analysis.
BATCH AND MEDIUM QUANTITY PRODUCTION
work measurement
LARGE QUANTITY PRODUCTION
micro time standard data
asymptotes are tolerances of the basic sample and depend on the size of the basic sample
increasing tolerance of time forecast
68%
95%
99%
LEVELS OF CONFIDENCE
increasing number of items or cycles in the sample

Fig. 11. Effect of number of items or cycles on tolerance and confidence of a forecast

the Table below. It will be seen that the practical sample size which is, say, a pay week or a cost batch, increases from one to many thousands over the range of production. This has been suggested in Figure 11 by applying the ranges of the different types of production to the diagram.

CHARACTERISTICS OF ENGINEERING PRODUCTION WHICH ARE RELEVANT TO THE CHOICE OF METHOD OF EVALUATING TIME STANDARDS

Characteristics	*Heavy Metal Fabrication Industry Small Quantity Production*	*Batch and Medium Quantity Production*	*Large Quantity Production*
Cycle time	Few hours to fraction of an hour	Few minutes to fraction of a minute	Few seconds to fraction of a second
Element time	Hours and minutes	Seconds	Fractions of a second
Cycles per Hour	Less than one to tens	Tens to hundreds	Thousands
Practical sample size, i.e. pay-week cost batch, etc.	Units to hundreds	Hundreds to thousands	Many thousands
Variability of Cycles	Few cycles are similar in element composition	Most cycles are similar in element composition	Almost all cycles are exactly similar in element composition
Variability of Elements	Method and time of element not repeated	Element repeated in method, slight variation in time	Elements almost exactly repeated in method and time

Accuracy in relation to existing methods of time forecasting or estimating for all types of production

For large quantity production, the production consists of very large numbers of almost alike work cycles, i.e. similar hand movements, machine operations, etc. Any random sample is likely to have very similar composition to the whole production. Any basic or estimating sample contains a large number of cycles. It is, therefore, possible to measure standard data, for example, manual motion elements, and to expect these to apply to a wide range of large quantity production. A method of time forecasting or estimating which is often applied is the use of micro-time standard data.

For batch and medium quantity production, the production still consists of considerable numbers of fairly similar cycles. A random sample is still fairly representative, while any practical sample contains a large number of cycles. It is, therefore, possible to measure relations for small basic samples divided into elements and to synthesise the relations and apply them to the large size estimating samples. The applicable method of time forecasting or estimating commonly applied in this range is what is currently known as element time study.

For small quantity production, the production consists of cycles which may be very widely dissimilar, while the practical sample size is small.

It will be seen that however variable production may be, provided representative samples are taken and provided enough samples are taken, it *is* possible to obtain a value of the mean with considerable accuracy. The more measures which are taken, the greater becomes the accuracy of the mean. There is a square root effect ; if four times the measurements are taken, the accuracy of the mean is doubled. In the theoretical approach or laboratory test approach of the welding example, repeating calculations or laboratory tests adds very little to the accuracy of the resulting data in relation to production. There is no tendency for the estimate or laboratory mean to approach the total production mean.

The types of cost data required for various management purposes

Cost data are required by management as follows :

(*a*) for design development to reduce production cost. For this purpose, information on *actual* costs is required in a form that allows the production costs of designs to be estimated quickly, cheaply and with appropriate accuracy. This implies information related to simple physical properties which can be measured from a drawing, e.g., such properties as weight, volume, area, length and number.

(*b*) for process, machine and method development to reduce production costs. The essentials are actual costs related to a simple measure of output which forms the link between diverse output, a separation of important process variables and a measure of the accuracy of the resulting data and relations ;

(*c*) for planning and progressing, the need is for information about actual production to be made available at a given level of detail, with a given degree of accuracy and at a minimum cost ;

(*d*) for incentive payment purposes, the cost data must relate to actual times taken for effective work and it should be possible to estimate the error of any cost forecast ;

(*e*) for methods of continuous control of labour and plant efficiency, the need is for data in a form that will allow the methods of the well known quality control systems to be applied to cost control.

The difference between standard and actual conditions

The element time study approach, for example, depends on the standardisation of all variables affecting the time study before the studies are made. This is often impossible in the highly variable production under discussion. The standard or specified conditions and the actual conditions cannot be made to coincide as is required to occur in the element time study technique, and a difference remains, which may often be wide.

In consequence, the times obtained from measurement at standard conditions may only represent a target and be of little value for those management purposes that require actual costs.

However, the measurement only of the existing situation may result in time standards being obtained which depend on variables, the values of which are less favourable than they might be.

These two points may be illustrated by an example.

The actual mean volume of unit length of a weld is say 3 cu. in., while the target volume, if all dimensions and fits were perfect, is say 2 cu. in. The latter figure is only of value as a target against which subsequent efforts to reduce the actual volume may be assessed. Data to be used for any of the management purposes described above must be based on 3 cu. in., *at this stage*. If joint fit can be improved by better inspection or machining methods, for example, then the new mean volume will require to be measured, say 2.5 cu. in., and this becomes the standard at this next stage. There is no alternative with such intractable, non-standard, variables but to adopt this experimental approach. In practice, with any such variable, method study as generally understood, may enable improvements to be made before any measurements are taken and this should always be done. This avoids the danger, for example, of confirming bad practices in an incentive scheme.

The specification for new methods of cost forecasting

Having considered the nature and implications of highly variable small quantity production, the types of data needed by management and the consequences of the difference between actual and standardised conditions, it is possible to specify requirements for a

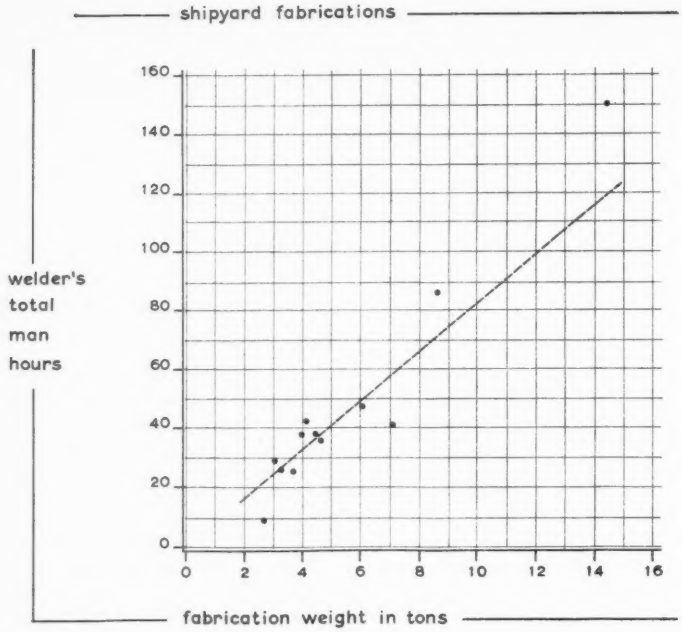


Fig. 12. Welders' man hours plotted against fabrication weight in tons

satisfactory method of cost forecasting in this field as follows :

(*a*) actual production work should be measured during actual production ;

(*b*) sufficient data should be obtained to enable the amount of variation of important factors and their effect on the variation of the input-output relationship to be assessed ;

(*c*) the accuracy of any time standard should be assessed ;

(*d*) the values of variables and conditions occurring during a series of sampling tests should reflect the normal working conditions with all normal variations allowed to occur freely ;

(*e*) it should be possible to separate the effect of labour effort from the effect of other variables on output.

The new statistical and analytical methods

The new methods described below depend on a number of familiar ideas :

1. the sampling of production ;
2. the measurement of a measure of input (e.g., man hours, material consumption) and a corresponding measure of output (e.g., tons of fabricated steel produced, feet of $\frac{1}{4}''$ fillet weld completed, etc.) ;
3. the obtaining of a number of values of input and corresponding values of output over the practical range of values that these input and output factors can have ;
4. the plotting of these values on a graph ;
5. the assessment of the correlation and the relationship between input and output by regression analysis ;
6. the successive substitution of various measures of output for a given input until the measure yielding the best correlation is obtained ;
7. the improvement of this relationship as required by increasing the number of input-output values or by grouping the values ;
8. the introduction of additional variables, one at a time, to create additional relationships and graphs. If possible these additional variables are chosen so that they do not interact, and so that they provide a common framework for values which would otherwise be in a number of separate groups.

This approach is illustrated by reference firstly to the welders' clock hours to complete welded shipyard fabrications ; and, secondly, to the directly effective time to make an arc weld. The first method has been called Total Production Analysis, as it is possible to deal with *all* production by this method. The second method depends on sampling production and is called Statistical Sampling and Analysis.

Total Production Analysis

In any shop, the total labour man hours can readily be allocated or split up into the hours of the different trades : the welders, platers and so on. Furthermore, in most shops (although this is not true of a shipyard) doing what might be called jobbing work (e.g., making pressure vessels, fabrications etc. of the one-or-two-off variety), each job is given a job number and the various labour hours are allocated

to this job number and to trades. Hence, for any particular fabrication, it is possible to obtain from existing records, the total welders' man hours. In this method of Total Production Analysis, the input times, in the present example, the total welders' man hours, are related with some measure of output which is a physical attribute of the construction, readily measured either in the shops or from drawings. The measure of output that is normally used in steel work is the tons weight of finished steel. The first step is therefore to relate the total welders' man hours with the weights of the various finished products. If this is done, the resulting graph might already be quite useful (Figure 12). The data shown relate to ship fabrications such as shell, deck and bulkhead units manufactured in the shops. For 95% confidence, the tolerance for one item is $\pm$ 44% of the mean, which is rather high. At 95% confidence, the tolerance of the mean of the 12 items is $\pm$ 13%. This means that if this sample were reasonably representative, there are 19 chances out of 20 that the mean value of man hours per ton does not differ from that for all similar production by more than $\pm$13%. If another twelve items are taken in this representative way and the man hours are estimated from the weights using the graph, there are 19 chances out of 20 that the total estimated man hours will not differ from the actual by more than $\pm$ 18%. If the size of the estimating batch is increased from 12, the tolerance will be reduced from $\pm$ 18%, but however large the estimating batch, the tolerance cannot contract below $\pm$ 13%.

To improve the accuracy of these data there are several courses open :

1. to increase the size of the basic sample, i.e., measure the weight and man hours for say a further dozen or so fabrications ;
2. to subdivide the production into groups such as bottom shell, side shell, bulkheads, etc ;
3. to introduce a new variable.

The procedure with (1) and (2) is quite straightforward and, in fact, if the number of items in the sample is increased and each point on the graph labelled, it may become apparent that there are several lines for different groups of points. This grouping can be tested by statistical methods.

However, there are several advantages in procedure 3, i.e., introducing a new variable. One that seems to be particularly valuable for welded steel work is the " feet of joint " which is, after all, what is being worked on by the welder (Figure 13). There are now three ratios or three relationships : the man hours per ton, the man hours per foot of joint, and the feet of joint per ton (Figure 14). The first two are productivity indices and the feet of joint per ton is a value which begins to describe the sort of fabrication under consideration. If man hours are plotted against feet of joint, it is often found that the relation can be approximated by a straight line, with the points scattered about the straight line (Figure 15). By doing this the tolerance for 1 item at 95% confidence is reduced from $\pm$ 44% of the mean for man hours per ton to $\pm$ 29% for man hours per foot of joint. The tolerance of the mean is now $\pm$ 6%, and the error of a further estimate of the man hours for 12 items is approximately $\pm$ 8%.

" Feet of joint " is not always a better measure of output than " weight in tons." This may be explained by referring to the effect of thickness, which may be introduced by plotting two graphs : (1) the man hours per foot of joint against average plate thickness, and (2) the feet of joint per ton against average plate thickness.

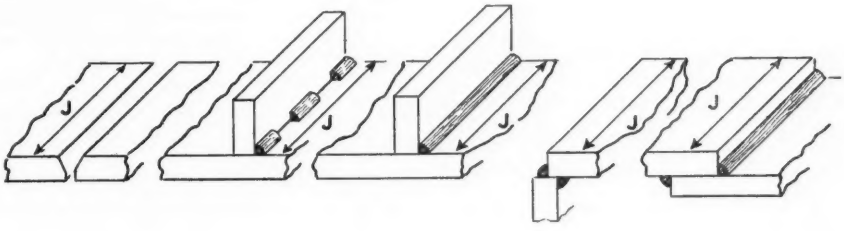
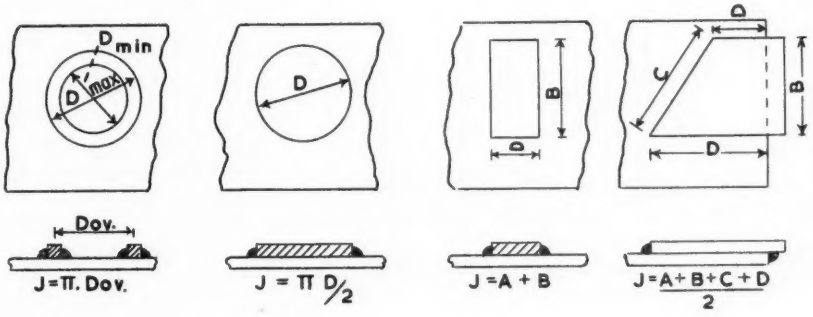


Fig. 13. Definition of length of joint



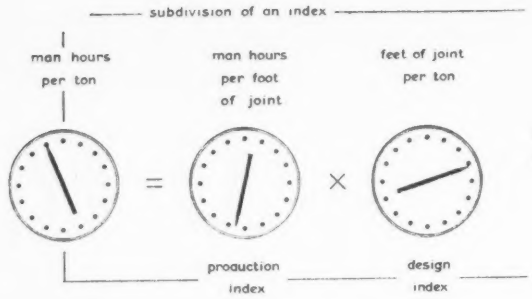


Fig. 14 (left) The relationship between man hours per ton, man hours per foot of joint, and feet of joint per ton.

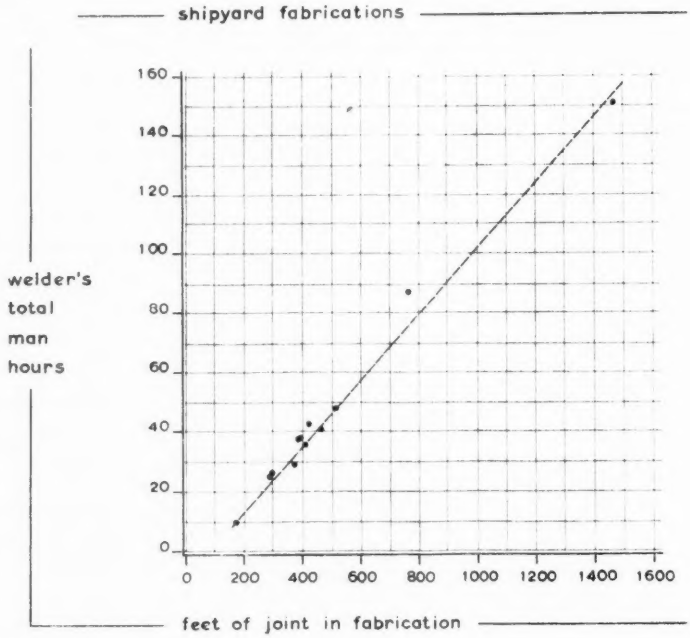


Fig. 15 (right) Welders' man hours plotted against feet of joint in fabrication

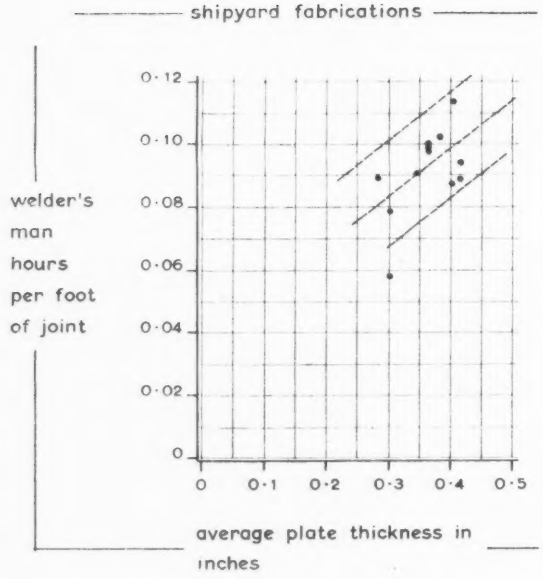


Fig. 16 (left) Welders' man hours per foot of joint plotted against average plate thickness

For the shipyard fabrications, the plotting of man hours per foot of joint against average plate thickness (Figure 16) does not improve the basis for estimating for the shipyard fabrications, but this may be because the range of thickness is small for so small a number of items. The error of a forecast for 12 items increases from ± 8% to ± 12%. This is not always so. For a large size range of tank-like structures weighing from 0.3 to 35 tons : the plot of man hours against weight is shown in Figure 17 and the forecasting error, on the basis already used, is ± 10% ; the plot of man hours against feet of joint is shown in Figure 18 and the forecasting error is ± 13% ; the plot of man hours per foot of joint against average plate thickness is shown in Figure 19 and the forecasting error is reduced to the low value of ± 5%.

An advantage of " feet of joint " in this second example as a measure of output is not that it, in itself, is superior to " weight in tons " but that it correlates with a third factor: " average plate thickness." This same advantage is not realised with the shipyard fabrications but " feet of joint " is, on its own, superior to " weight in tons " as a measure of output in this example.

Turning to the graph of feet of joint per ton against average plate thickness, there is seen to be a definite relationship both for shipyard fabrications (Figure 20) and for the tank structures (Figure 21). There is evidence of grouping on Figure 20 (confirmed by data from other shipyards) between the points representing bulkheads and those representing ' decks, shell and casings." It is also of interest to note in Figure 21 that the effect of decrease of joint length per ton with thickness is almost exactly cancelled out by the effect of increase of man hours per foot of joint with thickness (Figure 19). Consequently, the man hours per ton for this type of fabrication are surprisingly constant as size and thickness increase and this explains why, in this example, a better correlation was obtained between man hours and " weight in tons " compared with that between man hours and " feet of joint."

The graph of man hours per foot of joint against thickness and of feet of joint per ton against thickness enables estimates of man hours per ton to be made from knowledge of average thickness only. Also, a separation is achieved between the design function and the manufacturing function.

An experimental approach

The approach is the experimental one of establishing relationships on graphs. If, for example, on either of the graphs which have been discussed, a product group (e.g., pressure vessels) is found to group in points in one part of the graph, and another group (say transformer tanks) on another part of the graph, then it would indicate that rather than combining all this production together for estimating purposes, it would be better to have two graphs—one for each type of production.

The advantage of this approach is that all the production of a works can be plotted continuously, provided the various items are given job numbers

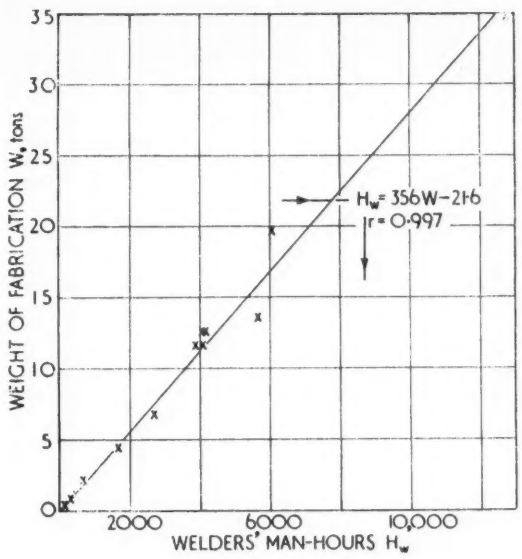


Fig. 17. Tank structures — welders' man hours plotted against weight of fabrication

and the labour man hours allocated to the job numbers. The average plate thickness and the feet of joint can be obtained from drawings. There are no shop measurements involved at all and the data which are obtained are total production data which are of particular value to higher management ; that is, for the broad decisions which, for example, will perhaps compare the productivity between different shops or enable broadly different designs to be compared. The data are approaching the marketing end of the organisation and are particularly valuable because they describe the sort of results that affect whether the company makes profits or losses. On the other hand, the data are of less use to those closer to the shop floor, the shop managers, welding foremen.

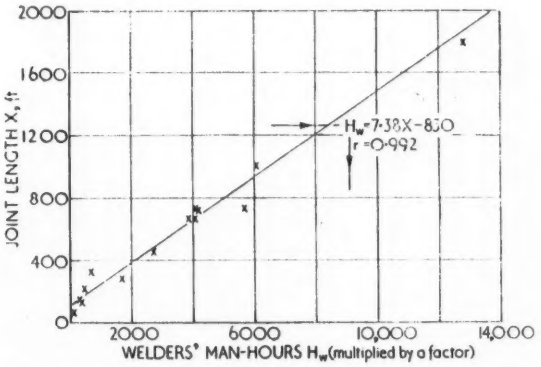


Fig. 18. Tank structures — welders' man hours plotted against joint length

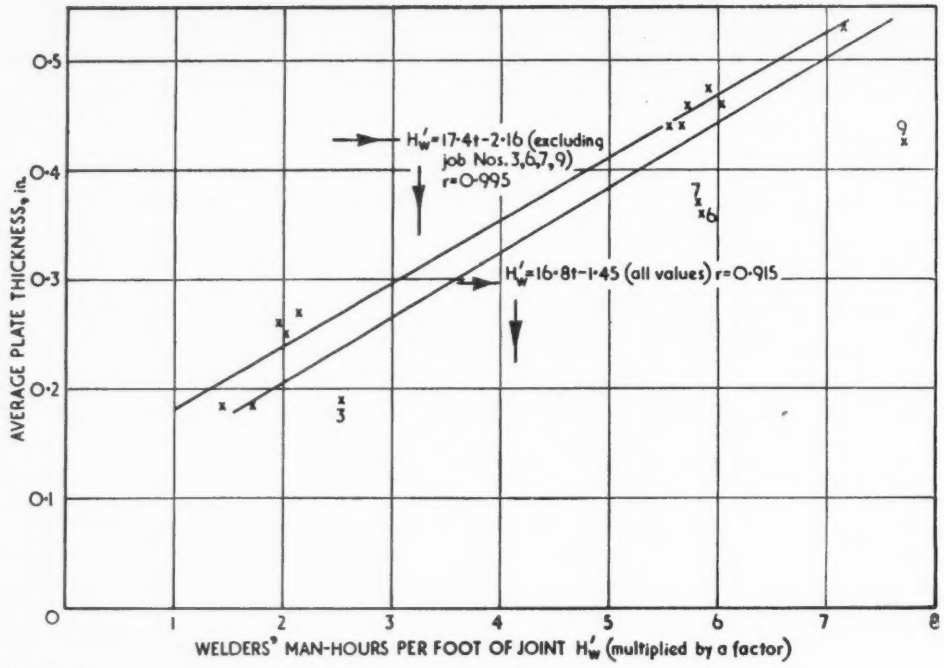


Fig. 19. Tank structures — welders' man hours per foot of joint plotted against average plate thickness

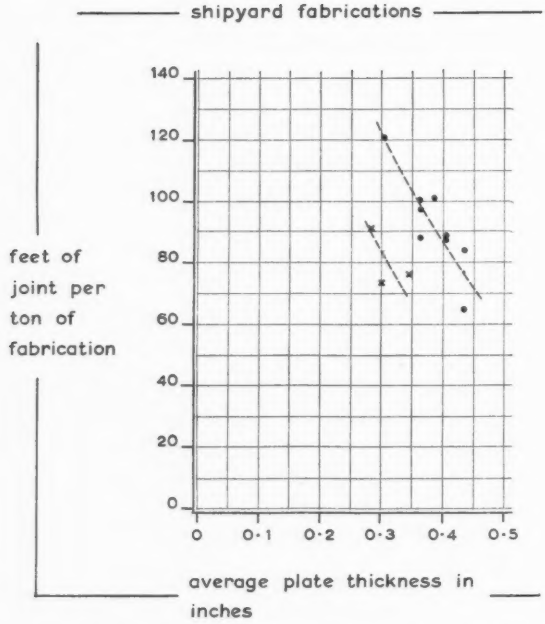


Fig. 20. Feet of joint per ton plotted against average plate thickness

welding engineers, who are deciding, for example, which process or electrode to use. This is because they are not sufficiently sensitive to the smaller yet important changes which it is hoped will be made on the shop floor to increase productivity. If a number of effective changes are made on the shop floor, then they will ultimately be reflected in the broad picture, but their immediate effect will be less obvious and something more sensitive is required to resolve this.

This broad method is analogous to looking at something under a low-powered magnifying glass. Some idea of what is happening is obtained but not of deeper causes. For this a microscope is needed. It will not now be possible to examine the whole, but only chosen parts representative of the whole. On the other hand, it is of no advantage to use a more powerful microscope than necessary. The procedure is adopted, therefore, of using a microscope of gradually increasing intensity until the important factors are resolved sufficiently to enable decisions to be made.

Statistical Sampling and Analysis

When the higher powered microscope of Statistical Sampling and Analysis is applied, it is found necessary to subdivide the welders' man hours. For most purposes it is only necessary to make a single subdivision and to differentiate between the directly effective welders' man hours (arc time, electrode changing and deslagging times) and the other welders' man hours (indirectly effective and ineffective time).

On the output side a number of subdivisions or classifications are necessary (Figure 22). Shop welds are separated from site welds, or berth welds, butt welds from fillet welds, and hand welding from machine welding. It will probably be necessary to separate the positions of welding : downhand, vertical and overhead. Butt welds, for example, will be separated into the various types, e.g., close square butt, single Vee and double Vee. Fillet welds may be classified into ordinary fillet welds and corner welds.

Shop time study

At this stage of subdivision, shop time study is required. The only time that is of concern, if the welder is studied while doing a certain length of weld, is the directly effective time. If the welder's co-operation can be obtained, and he starts the weld and works through steadily to the other end of the part being studied, then all that is necessary is to note the commencing and finishing time with an ordinary pocket watch, which by difference gives the directly effective time for a measured length of weld. If there are any delays during the making of the weld it is not difficult to make notes of the times at which delays commence and finish.

Taking this simple basis for the 80 vertical single vee butt welds previously referred to(p.771), the different plate thicknesses and the directly effective* times are plotted one against the other, giving a graph (Figure 23). The approach is directly to measure the one factor that it is required to estimate and forecast ,that is, the directly effective time. This has been related with output, which here is unit length of weld of a particular size and type.

It has been estimated that if the mean line is used to forecast the net productive time for one welder's work for one week which is approximately 16 butt welds, the error of the forecast should not be greater than $\pm$ 12%, for 19 weeks out of 20. For a group of five welders working as a team, the error of a forecast of the net productive time worked during one week should not be greater than $\pm$ 6½%, for 19 weeks out of 20. Alternatively, for one welder, the error of the net productive time worked during five weeks should not be greater than $\pm$ 6½% for 19 periods of five weeks out of 20.

The graph would be more useful if some factor could be introduced which would give a measure of the weld volume and some measure of the variation caused by the weld volume. This can be done by introducing a further variable, " the feet of electrode fused per foot of joint." It may be shown theoretically and it will be seen from this example that it is true practically, that the directly effective time per foot of joint is proportional to the feet of electrodes fused per foot of joint. The feet of electrodes fused for a particular pattern of electrode procedure—say for electrodes of all one size—gives a measure of the weld volume. A double graph is thus obtained (Figure 24). The weld size is the left x axis, the feet of electrode

* The synonomous term " net productive time " is used on some of the illustrations.

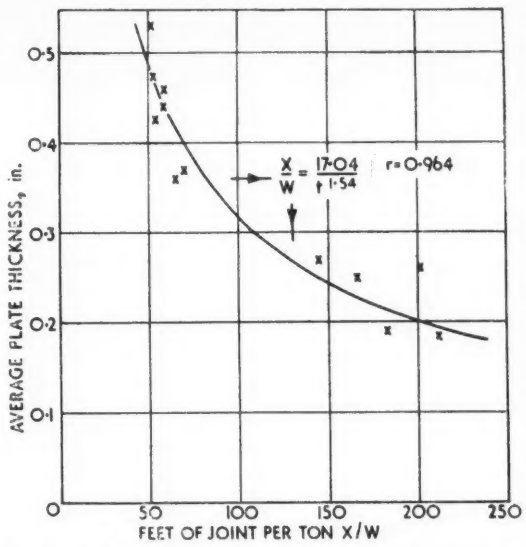


Fig. 21. Tank structures — feet of joint per ton plotted against average plate thickness

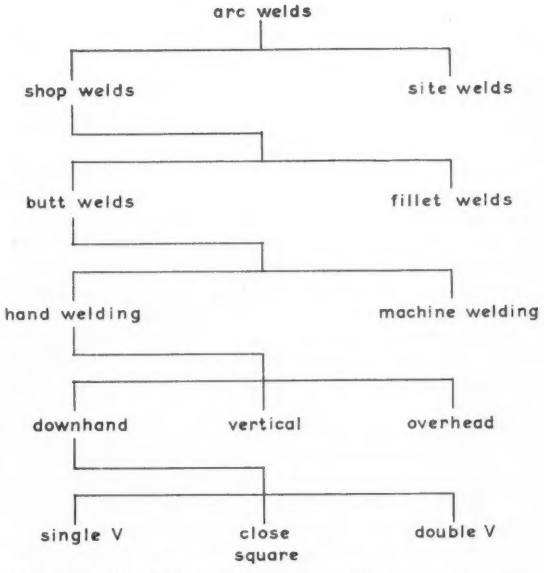


Fig. 22. Subdivision of welders' hours in arc welding

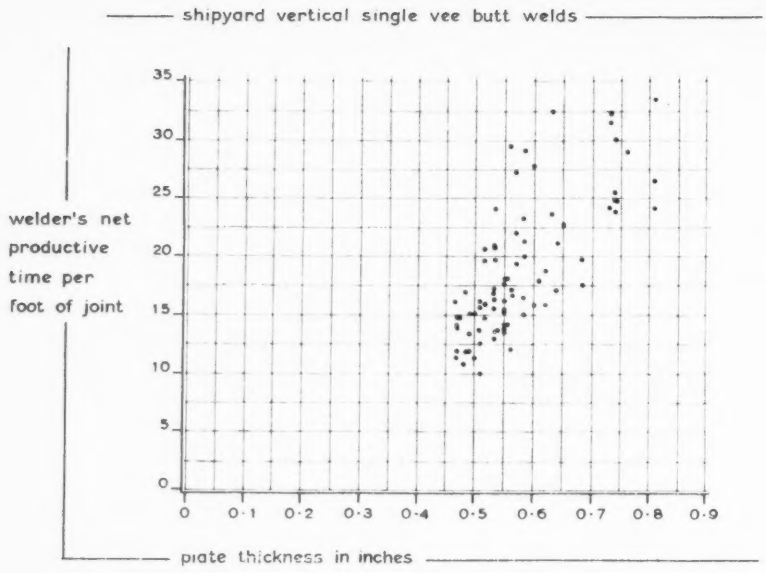


Fig. 23. Welders' net productive time per foot of joint plotted against plate thickness

fused per foot of joint is the ordinate, and the net productive time per foot of joint is the right hand x axis. A subdivision has been made which increases the usefulness of the data considerably. The feet of electrode fused per foot of joint can be very simply obtained during the time study test by collecting the stub ends of the electrodes.

For a given welding procedure (specification of size of electrodes in the different runs, in the length of weld per electrode and so on), the scatter of points on the left hand graph represents the variation of weld volumes occurring in the welds measured. There is little difficulty in separating the effect of the different electrode sizes and thus obtaining the weld volume directly. The example chosen here includes welds made with only one size of electrode. The inclusion of a further graph is necessary to take account of different electrode sizes and procedures, but it is a theoretically derived graph and its omission here does not affect the discussion essentially.

The left hand side represents the field of responsibility of the shop management, that is : the weld volumes, the fit of the joint and the procedures which the management recommend the welder to use. The right hand side largely reflects the welders' effectiveness. Immediately one point of interest arises—the right hand side is the only side that need be considered for incentive payments. The question of joint fit and electrode size has been split off from incentive considerations, which is a useful practical advantage.

Other advantages of this method are :

1. The estimation of the time for an estimating sample involves the specification of few quantities, which may be readily measured from a drawing or found from production. Thus to estimate the time per foot of welded joint, of a particular type from the relations of Figure 24, it is only necessary to specify the length and size of these welds. The relations and the statistical effect take care of the other many variables as they have been found to occur in production.
2. In the estimating procedure there is only one simple computation from a graph or tables.
3. There are no assumptions with regard to variables or relations because these are derived from actual observations of productions, and in consequence reflect " the existing situation."
4. An estimate is made of the tolerance and confidence of each relation on which depends a number of management uses.

Practical use of data

Estimates of time for design appreciation and development, cost estimating, planning and progress procedures and for comparison of processes, machines and methods are based in these methods on relations obtained from actual production, which are accompanied by their tolerance and confidence. Consequently, the best estimate is obtained and the validity of the estimate may be examined. For example, the tolerance and confidence of a cost estimate will follow from the tolerance and confidence of the relations making up the estimate. If such an estimate showed a tolerance of $\pm$ 10% with a confidence of 95% (19 out of 20) and if the estimated profit margin were 10%, it would mean that 1 in 20 items made would either make a profit of greater than 20% or a loss, i.e., that 1 in 40 items would show a loss. Alternatively, if only one item were being produced, there would be 1 chance in 40 of making a loss on the item.

In the comparison of designs, processes, machines and methods, the tolerance and confidence of the

cost per unit of output for each of the items being compared may be found. From these, it is possible to estimate the probability that the difference between the mean values measured is real, or whether it is accidental, by means of statistical significance tests. In more practical terms, this means that any estimate of difference, say that (x) is 20% better than (y) is accompanied by an estimate of the probability of being right, say 68% or 95% or 99% corresponding to the conclusion being not safe, fairly safe, and quite safe, i.e., to varying degrees of confidence.

The importance of making comparisons in this form in heavy engineering fabrication production (as in experimental work, science, medicine and agriculture, for example) cannot be over-emphasised. A " fairly safe " conclusion may be acceptable if the outcome is relatively unimportant but may be most unacceptable in an important situation. The confidence required is clearly dependent upon the importance of decisions to be made. If this is specified the investigation can be planned to give the appropriate confidence.

Estimates of time for assessment of labour efficiency and incentive payments are again accompanied by the tolerance and confidence. For example : as a result of an investigation it may be shown that the directly effective time (a basis for incentive payment) can be estimated from output, for one man for one week, with an accuracy of $\pm$ 10% in 19 weeks out of 20. This is a basis which might, perhaps, commend itself to those responsible for negotiations. The risk of not getting paid exactly for the directly effective time worked is stated and can be accepted or rejected. An improvement in accuracy may be obtained by increasing the sample size, which means that over a sufficiently long period the error in payment will only be that of the initial basic sample. If the accuracy of this latter is in doubt, an estimate is already available of the increase in accuracy likely to be obtained on making further time and production studies. It is apparent that a basis becomes available for heavy fabrication engineering production for what in another context (that of quality control) is called the sharing of producers' and consumers' risk.

Finally, the tolerances for given confidences may be considered as control limits for the relations between time and output, with intermediate relations between process variables and time, and process variables and output. The tolerances appropriate to, say, the 95% and 99% confidences may be called the warning and action limits respectively, using the well-known terminology of quality control techniques. Continuous control of the relation reflecting plant and/or labour efficiency may be exercised, by taking periodic samples of production and inserting them in the control chart. Their position will indicate warning of an improvement or deterioration or will signal the necessity for action. If, for example, several samples consistently group about a lower warning limit, it means that the value of the relation for the production has significantly changed, and that it is time to establish new standards.

In conclusion, it is apparent that the activity of continuously revising time standards is a good indication that productivity is being increased, and the graphical and rigorous basis of the methods described in this Paper might perhaps encourage this dynamic approach.

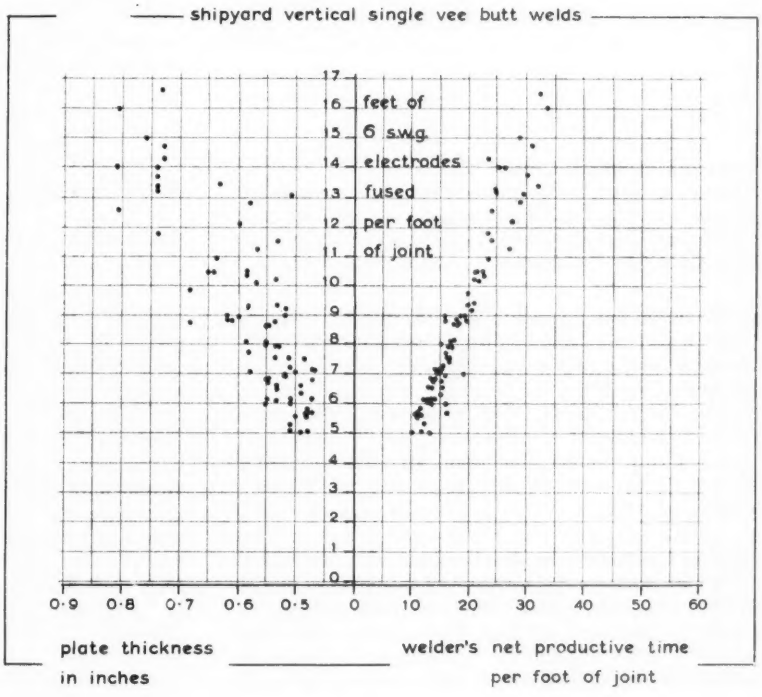


Fig. 24. Welders' net productive time per foot of joint plotted against feet of electrodes fused per foot of joint in turn plotted against plate thickness

REPORT OF

THE MEETING OF COUNCIL

Thursday, 31st October, 1957.

THE second Council Meeting of the 1957 - 1958 Session was held at 10 Chesterfield Street, London, W.1, on Thursday, 31st October, 1957. The meeting, at which the Chairman of Council, Mr. H. G. Gregory, presided, was attended by 28 members.

Before proceeding with the business of the meeting, the Chairman expressed regret that Mr. F. T. Nurrish, M.B.E., was unable to be present because of illness, and it was unanimously agreed that the good wishes of Council for a speedy recovery be sent to Mr. Nurrish.

Finance

It was reported by the Finance and General Purposes Committee that increased postage and telephone charges had forced the Committee to amend the budget for the current financial year. The financial policy of the Institution was fully discussed by the Council after the routine business had been dealt with, and a number of suggestions were made which will be examined in detail by the Finance and General Purposes Committee.

Production Exhibition and Conference, 1958

The Advisory Committee, under the Chairmanship of Lord Halsbury, had met on several occasions, and a sub-committee had been established to look after the detailed arrangements.

Qualifications for Associate Membership (Article 15)

Following the discussion at the last Council Meeting, legal opinion had now been obtained and was being examined by the Finance and General Purposes Committee. The proposed amendment would be submitted to the membership for approval at an Extraordinary General Meeting on 30th January, 1958, immediately following the Annual General Meeting.

Ad Hoc Committee on Implications of Automation

The Finance and General Purposes Committee submitted to the Council a Report from Mr. A. F. Kelley, Chairman of the Institution's *Ad Hoc* Committee on the Implications of Automation. The members of this Committee had reached the conclusion that no useful purpose would be served, at this time, by the Institution publishing a report on the Implications of Automation with special reference to human problems, and permission was therefore granted to dissolve the Sub-Committee.

Institution Annual Dinner, 1957

The Secretary reported that although the attendance at the Annual Dinner on 4th October had been slightly lower than usual, the function had been most enjoyable, and the Institution had been exceedingly fortunate in their Guest of Honour, Sir John Maud. He had given the members a brilliant address. (*The speeches by Sir John Maud and by the President, Lord Halsbury, appear in this issue of the Journal.*)

Society of Polish Mechanical Engineers

The Secretary reported that an insufficient number of members had indicated that they would be able to take part in the Institution visit to Poland at the time arranged. Negotiations were taking place with the Secretary of the Polish Society regarding a visit in the Spring of 1958, and the Council would be informed as soon as a date had been agreed.

Schofield Travel Scholarship, 1957

The Education Committee reported with pleasure that the winner of the 1957 Schofield Travel Scholarship was Mr. J. Parson, Graduate, who was Senior Methods Production Controller at Solartron Engineering Ltd. Mr. Parson proposed to spend three months in the United States of America, studying manufacturing techniques of small electro-mechanical mechanisms.

Broadening the Base

It was also reported by the Education Committee that the majority of the syllabuses for the proposed examination structure have now been prepared and approved, and specimen examination papers were being drawn up. It was anticipated that the Committee's recommendations on the new examination structure would be placed before the January meeting of Council.

Membership

The Council approved a number of applications for membership and transfer, details of which appear on pages 788 - 789 of this Journal.

The Journal

The Editorial Committee were pleased to report that over the year ending on 30th June, 1957, the Journal had not been a financial charge on the Institution, in spite of the fact that costs had risen steadily and the size of the Journal had been increased. It was hoped to maintain this satisfactory state of affairs over the coming year, but the increase in postal and telephone charges, which came into operation on 1st October, meant that the Committee would have to keep an even closer check on production costs. The possibility of using an even lighter weight of paper for the advertising pages, in order to keep down postage charges, was being investigated.

With regard to advertising, the future trend did not appear to be unsatisfactory, but every effort must be made to maintain and increase the sale of advertising space in order to offset the increased charges already mentioned. In this respect, the Committee pointed out that this aim could be very largely achieved if all members of the Institution who were in a position to do so would support the Journal by taking some advertising space, however small.

Institution Papers

The Papers Committee reported the following arrangements for the presentation of the 1957 Institution Named Papers :

(a) *The George Bray Memorial Lecture*. This would be presented at the University of Leeds on 24th March, 1958, by Dr. V. E. Yarsley, whose subject would be : " The Fabrication of Plastics ".

(b) *The Sir Alfred Herbert Paper* would be given at the Royal Institution on 31st October, by Dr. H. Barrell, of the National Physical Laboratory, who would speak on : " The Bases of Measurement ".

(c) *The Viscount Nuffield Paper*. The Right Hon. The Lord Hives had accepted the Institution's invitation to present this Paper, which would be given at the University of Bristol on 6th February, 1958. Lord Hives was expected to speak on : " Technical Education for Production Engineers ".

Research Committee

The following reports were made on behalf of the Research Committee :

Materials Handling Group. The Group had met three times during the quarter and each Region and Section of the Institution had been asked to appoint a representative who would be willing to take part in the activities of the Group. Full particulars and the conditions of membership of the Group had been published in the Journal.

The main activity of the Group had been the organisation of the Materials Handling Convention which took place at Leamington Spa from 28th - 30th October, and was preceded by a meeting of Region and Section representatives. There were 115 delegates to the Convention, and many expressed their satisfaction and interest in the arrangements made.

Material Utilisation Sub-Committee. The Notes for Guidance were circulated to Regions, Sections and affiliated firms at the beginning of July, and case studies were now beginning to come in for consideration by the various panels.

Sources of Information Sub-Committee. It was hoped that the Directory on Sources of Information would shortly be ready for publication.

Control of Quality Sub-Committee. Meetings had been held during the quarter and progress was being made with the preparation of the Report, which was now nearing the final draft stage.

Joint Research Committee with I.C.W.A. There had been no meeting of the Committee during the quarter, but the Sub-Committees were proceeding with their investigations into " Electronics and Kindred Modern Developments as Applied to Process Loading " and " The Effective Use of Shiftworking in Industry ".

Standardisation

It was reported by the Standards Committee that terms of reference for a Sub-Committee on International Standards had now been agreed, and the Sub-Committee was being formed under the Chairmanship of Mr. T. A. C. Sparling.

The Sub-Committee on Unit Heads, under the Chairmanship of Mr. J. A. W. Styles, had prepared a draft of headings for submission to the B.S.I., in support of the Committee's recommendation that the B.S.I. Technical Committee should extend its investigations to include the consideration of mechanical performance and dimensions.

The Joint Standing Advisory Committee on the Use of Standards in Industry had met once during the quarter. Plans were being made for the fourth Conference of Standards Engineers, to be held in 1958.

The Library

The Chairman of the Library Committee, Mr. H. L. Madeley, said that the greatest use of the Library was made in the London area. The Committee felt that perhaps the provincial Sections were not fully aware of the extent of the Library services, and steps were being taken, accordingly, to make sure that members outside London had this information.

Region and Section Reports

The Council received a number of reports from Regions and Sections, extracts from which appear on pages 790 - 794 of this Journal.

Sections outside the U.K.

The Vice-Chairman of Council (Mr. H. W. Bowen, O.B.E.) reported that there had been few visitors from overseas during the quarter, but there was continuous contact by means of correspondence with Sections outside the U.K.

The Australian Sections particularly seemed to be extremely active. The second James N. Kirby Paper, presented in Melbourne in September, had attracted an audience of over 400 members and visitors. The

speaker was Mr. Walter Scott, an internationally known management consultant, who spoke on "Operation Future — The Engineer in a Changing World". A copy of the Paper has been submitted for consideration for publication in the Journal.

At the Annual Dinner of the Melbourne Section, in November, the guest of honour was to be Sir Douglas Copeland, Principal of the recently formed Australian Administrative Staff College.

It was proposed that the third James N. Kirby Paper would be presented in Adelaide in October, 1958. The Adelaide Section would be responsible for the arrangements and had asked that they be informed if any member of Council or other prominent production engineer would be visiting Australia at that time, and would be open to an invitation to present this important Paper.

The South African Council, also, appeared to have been extremely successful in their choice of speakers at Institution functions. The guest of honour at the Annual Dinner in August had been Mr. Gideon Ross, Director-General of the South African Broadcasting Corporation.

Mr. Bowen had also received a long and interesting letter from Mr. Bhattacharji, of the Calcutta Section, who had been very energetic on behalf of the Institution.

A report from Mr. de Sousa, Chairman of the Bombay Section, confirmed the difficulties of obtaining the right type of member in India, and of making up a suitable lecture programme. Much credit was due to Mr. R. A. Farman, until recently Secretary of the Bombay Section, for his efforts on behalf of the Section, as well as to the two Committees for their excellent work in spite of considerable difficulties.

The Council received these reports with great interest and would make sure that they received the full consideration of the appropriate Committees.

Obituary

The Council recorded with deep regret the deaths of the following members:

Members: B. S. Allan; J. W. Berry; T. McCulloch; P. M. Davidson; E. E. Tournier.

Associate Members: C. M. Burgess; W. Butler; J. M. Martin; S. Russell; E. Sweeney; C. W. Warner; F. Westhead; C. E. Wortley.

Associate: K. R. Kotalah.

Graduate: B. F. W. Southall.

Date and Place of Next Meeting

It was agreed that the next meeting of the Council would take place on Thursday, 30th January, 1958, at 10 Chesterfield Street, London, W.1, at 11 a.m. The Annual General Meeting would take place at 2 p.m. on the same day.

ELECTIONS AND TRANSFERS

31st October, 1957.

ADELAIDE SECTION
As Associate Member
K. J. Franks.

BIRMINGHAM SECTION
As Associate Members
B. H. Horton, J. Dickson.
Transfers
From Students to Graduates
A. K. N. Al-Kamil, T. P. James.

BOMBAY SECTION
As Student
S. C. Bhattacharya.

CALCUTTA SECTION
As Graduate
A. Mukhopadhyay.
Transfers
From Associate Members to Members
S. R. Chatterjee, J. S. Claire.

CANADA SECTION
As Students
P. E. Sulman, V. E. Locker.
Transfers
From Graduates to Associate Members
W. S. Chipping, R. Springham.

CARDIFF SECTION
As Student
S. Taylor.

COVENTRY SECTION
As Graduates
D. W. Chester, B. A. Richardson.
As Students
J. R. Wildsmith, A. Jackson, P. Reece.
Transfers
From Graduates to Associate Members
W. N. Aspinall, A. G. Gulliver, D. C. Bear, I. Wharton.
From Students to Graduates
K. J. Miller, T. W. Harman, N. I. Tyler.

DERBY SECTION
As Graduates
R. Sampson, F. P. Read, D. C. Harvey.
Transfers
From Graduates to Associate Members
I. W. Mackintosh, A. G. Farnsworth, D. H. Goss.

EDINBURGH SECTION
As Graduate
J. Bell.

GLASGOW SECTION
As Associate Members
J. R. Campbell, S. A. Young.
As Graduate
W. S. Moffat.
Transfers
From Graduates to Associate Members
J. F. Mitchell, F. Devine.
From Student to Graduate
J. Walker.

GLOUCESTER SECTION
As Associate Member
J. Leather.
As Graduate
B. Stuart.

HALIFAX & HUDDERSFIELD SECTION
As Students
B. Fielden, G. F. Stead.
Transfers
From Graduate to Associate Member
F. Ainley.
From Student to Graduate
R. Dixon.

IPSWICH & COLCHESTER SECTION
As Associate Member
D. G. Petch.
As Graduate
M. D. Blake.

LEEDS SECTION
As Graduate
W. C. D. Blower.
Transfer
From Graduate to Associate Member
A. Shaw.

LEICESTER SECTION

As Graduates
J. Higginbottom, A. R. Corbett, R. J. Cowie, W. G. A. Vaizey.

Transfer
From Student to Graduate
K. H. Gollaglee.

LINCOLN SECTION

Transfer
From Graduate to Associate Member
M. Daniels.

LIVERPOOL SECTION

As Member
W. Burrows.

As Graduate
R. Adamson.

As Students
T. E. Drysdale, S. W. Smith, J. Poland.

Transfers
From Students to Graduates
C. Armstrong, R. A. Reeves.

LONDON SECTION

As Associate Members
P. N. Coe, M. E. Reed, H. G. J. White, L. A. Kettle-Williams, A. W. Thorpe, G. L. Burgess, E. J. Owen, H. R. Armfield, D. A. McGrotty, S. Majumder, S. A. Varndell.

As Graduates
A. C. Fry, R. C. Smith, K. C. Meagher, J. J. May, J. H. Flack, F. A. J. Clover, M. J. Paine, B. Mansell.

As Students
R. S. Grant, I. F. Spedding, P. Westcott, G. J. Frazer, P. C. Matthews, G. G. Wicks, S. J. Hancock, W. Stevenson.

New Affiliated Firms
Powers-Samas Accounting Machines Ltd.; English Numbering Machines Ltd.

Transfers
From Associate Members to Members
A. W. Arthurs, W. Hewett.

From Graduates to Associate Members
D. Royston, D. T. J. Ford, R. W. Rush, M. L. Bentley, J. W. Barray, A. Broady, J. A. DeCourcy, R. J. Mahlich, D. S. Gwynne.

From Students to Graduates
R. G. Powell, A. R. Dove, R. K. Charlton, P. H. Sturgess, K. J. Eagle, D. H. Ralston.

LUTON SECTION

As Associate Members
W. H. Hollis, G. J. G. Barnett, H. M. Nixon.

As Graduates
E. K. Ford, F. Woodgate.

As Student
R. G. Hall.

Transfers
From Graduates to Associate Members
J. D. Holland, I. A. White, E. Fell.

MANCHESTER SECTION

As Associate Member
F. G. Johnson.

As Students
B. Fletcher, F. Reddiough, R. T. Berry.

Transfers
From Graduate to Associate Member
K. Radford.

From Student to Graduate
A. Hackett.

MELBOURNE SECTION

As Member
R. Averay.

As Associate Member
E. C. A. Maskiell.

New Affiliated Firms
International Harvester Co. of Aust. Pty. Ltd.; Qualos Sales Pty. Ltd.; W. G. Goetz & Sons Ltd.

Transfers
From Graduate to Associate Member
A. R. Fee.

From Studeat to Graduate
A. K. Kenworthy.

NEW ZEALAND SECTION

As Associate Member
R. N. Miners.

NEWCASTLE SECTION

Transfer
From Student to Graduate
A. S. Waters.

NORTHERN IRELAND SECTION

As Associate Members
W. G. McIlwaine, T. McSorley.

Transfer
From Graduate to Associate Member
F. W. Huggins.

NOTTINGHAM SECTION

As Associates
H. D. Ward, A. R. Bingham.

Transfer
From Graduate to Associate Member
F. A. Mellors.

OXFORD SECTION

Transfer
From Graduate to Associate Member
R. M. Cooke.

PRESTON SECTION

As Associate Member
J. Connell.

As Graduate
G. S. Dodd.

As Students
K. Mangnall, R. C. Watts, B. Mawdsley, G. Glover.

Transfers
From Graduates to Associate Members
G. Greenhalgh, F. Yerkess.

From Students to Graduates
M. E. Whitaker, H. Cottam.

READING SECTION

As Member
A. E. Flowers.

As Student
A. K. Clarke.

Transfer
From Student to Graduate
D. G. Paice.

ROCHESTER SECTION

As Graduate
M. R. Wilson.

As Student
P. J. Donovan.

Transfer
From Graduate to Associate Member
W. R. Bruce.

SHEFFIELD SECTION

As Graduate
I. Senior.

Transfer
From Associate Member to Member
H. Stafford.

SHREWSBURY SECTION

As Student
A. R. Dinos.

SOUTH AFRICA SECTION

As Associate Member
D. A. Horton.

SOUTH ESSEX SECTION

As Associate Member
R. J. Worboys.

As Graduate
A. W. J. Pullen.

As Student
I. M. L. Ward.

SOUTHAMPTON SECTION

As Member
J. W. Chapman.

As Associate Members
R. L. Griffiths, R. F. Holman, R. Hastings.

As Graduate
P. A. White.

Transfers
From Graduate to Associate Member
B. L. Soane.

From Students to Graduates
F. F. Simmonds, G. Pettit.

STOKE-ON-TRENT SECTION

Transfer
From Student to Graduate
R. J. Spencer.

SYDNEY SECTION

As Member
A. Johnstone.

New Affiliated Firms
Mechanical Precision Equipment Pty. Ltd.; Hipsleys Ltd.

Transfers
From Graduate to Associate Member
J. H. Hudson.

From Students to Graduates
D. Richmond, P. Major, J. S. Ryan.

TEES-SIDE SECTION

As Member
J. O. Lumsdon.

As Associate Member
R. Bell.

WESTERN SECTION

As Associate Member
I. G. Davies.

Transfers
From Graduate to Associate Member
W. F. Hilton.

From Student to Graduate
C. R. Blake.

WOLVERHAMPTON SECTION

As Member
N. Robinson.

As Graduate
J. D. Smith.

As Student
J. T. Ball.

Transfers
From Graduates to Associate Members
D. Gutteridge, H. J. Turner.

From Students to Graduates
A. G. Saunders, D. N. Bird.

WORCESTER SECTION

As Associate Member
A. W. Balls.

As Student
M. J. Laight.

NO SECTION

As Associate Members
H. A. Schwarz, G. C. Tomlinson.

As Students
P. Middleton, D. S. Vaidya, G. Manasseh.

Transfers
From Graduate to Associate Member
J. Murgatroyd.

From Graduate to Associate
L. F. Daniels.

From Student to Graduate
M. H. Mahmood.

EXTRACTS FROM REGION AND SECTION QUARTERLY REPORTS

EAST AND WEST RIDINGS REGION

Doncaster

The Section has suffered a great loss due to the resignation of the Chairman, Mr. W. J. Edgington, J.P., who is, for the time being, leaving the country. To date his successor has not been elected.

The lecture programme for 1957/58 has been arranged and the Committee look forward to a very enjoyable and successful session.

Halifax and Huddersfield

The summer months have seen the curtailment of many of the activities of the Section, but two Committee meetings have taken place and the programme for next session has been prepared.

The first meeting will be the Regional Meeting at Huddersfield, when the speaker will be Mr. T. M. Higham, Chief Industrial Psychologist of Messrs. Rowntree, Yorkshire. His subject: " Selecting the Right Man for the Job—A Review of Modern Procedures ", promises something different from previous lectures and we are anticipating a very interesting and instructive meeting.

The Dinner-Dance, postponed from March of this year, is to be held on 25th October, in Halifax.

Mr. K. D. Walker, Head of the Engineering Department of the Percival Whitley Technical College, has informed the Section Committee that six students have taken advantage of the course arranged last year at the College, to enable them to take subjects which will qualify them academically for membership of the Institution. The Graduate Chairman, Mr. H. Scholes, who has recently returned from Switzerland and Germany, which he visited after obtaining the Schofield Travel Scholarship, intends personally to see these students to invite them to join the Institution.

Leeds

The syllabus for 1957/58 has now been completed and the first meeting of the session is the Regional Meeting at Huddersfield on 16th October, 1957.

An interesting series of lectures has been arranged and the Chairman is writing to each member of the Section requesting their support at all meetings.

Leeds Graduate

The newly-formed Leeds Graduate Section Committee have commenced their activities for the 1957/58 session.

A programme of works visits has been designed to see managerial organisation and production problems not directly concerned with the engineering industry. The programme consists of visits to the G.P.O. Leeds, The National Coal Board, a local brewery, an Electrical Power Station and also the Maintenance Department of the Leeds City Transport.

No lecture meetings have been arranged for this session but all Students and Graduates are invited to attend lectures organised by the Senior Section.

Sheffield

The Section Committee has discussed the suggestion that future Education and Membership Committee meetings should be held in London, on different days, each meeting to occupy a full day. The Committee feel that because both meetings have been held in Birmingham on the same day, there has been some restriction in representation and that both Committees have consisted mainly of the same members. It was suggested that a greater number of qualified members would agree to sit on these Committees if the venue was changed to London, since they could attend to other business the same visit.

The following resolution was carried:

" This Committee feel that the Education and Membership Committee should not consist of the same members, except the respective Chairmen, and that meetings should be held in London, on separate days, on dates to be specified ".

EASTERN REGION

Ipswich and Colchester

The activities of the Section during the last quarter have been confined in the main to the meetings of the Committee.

A visit took place in August to the R.A.F. Station, U.S.A.F. Bentwaters, which proved to be very interesting and included a tour covering the constructional activities involved in the laying of new runways. This was followed with a general tour of the workshops, covering the systems and production methods employed in the maintenance of jet engines.

The arrangements for the first social function held by this Section have now been concluded and this will be held on 18th October at the Royal George Hotel, Ipswich. The Guest of Honour will be Mr. J. Hill, Vice-President of the Institution. This function is expected to be a great success as it is open to all members of the Eastern Region.

MIDLANDS REGION

Regional Report

The Regional Conference, " Tooling—Tomorrow's Production ", held in Birmingham in May, 1957, attracted a large number of delegates; over 300 attended to hear a programme of eight Papers arranged in four sessions. Each Paper covered a specialised aspect of tooling and included presswork, cutting tools, jigs and fixtures for automation, welding and fabrication and gauging. The Conference was well reported in the national and local Press. Several of the Papers have now been published in the technical press, thus bringing the Institution's work to the notice of all concerned in industry.

During the coming session it is planned to hold Regional Meetings at Wolverhampton in December, 1957; and at Coventry in March, 1958. The subjects will be: " Nuclear Energy " and " Ceramic Tooling " respectively.

At the conclusion of the 1956/57 session, Mr. B. W. Gould retired from the office of Honorary Secretary. Mr. Gould had been in this office since the Regional structure was set up and rendered very valuable service to the Region and the Institution during his period of office. Mr. A. C. Turner was elected to serve as the new Honorary Secretary.

Birmingham

A very successful Summer Convention attended by 146 members and friends was held on 22nd June, 1957, when the works of Accles & Pollock were visited. After lunch, by courtesy of the Company, the party proceeded to Hagley Hall where tea was taken after a tour of the Hall.

The opening meeting of the lecture session took the form of a well-attended Film Evening. Films of a general as well as a

technical interest were shown and ladies were invited to accompany members. Tea was served prior to the showing of the films.

The formation of a working group to deal with Materials Utilisation has been initiated.

Birmingham Graduate

While the summer months have been quiet with little Section activity, the Section Committee have been fully occupied in the arrangements for the Third National Students and Graduates Convention, held at the Birmingham University on 14th September, 1957.

The title for this Convention was " Engineering for Existence ". The opening address was given by Dr. N. A. Dudley, Ph.D., B.Sc., M.I.Prod.E., Head of the Department for Engineering Production, University of Birmingham. This was followed by the first Paper " Improving Manufacturing Methods ", by Mr. C. R. Miller, A.M.I.E.E., A.M.I.Prod.E., a Management Consultant. The second Paper was given by Mr. D. G. Hilton entitled " Organisation and Methods ". Mr. Hilton is an O. & M. Manager.

After lunch Dr. Dudley gave a talk on the Research Work carried out by the Engineering Production Department of the University, this talk was supported by closed circuit television and projected slides. The final Paper, " Time is Money " was presented by Mr. H. H. Norcross, A.I.Prod.E., F.C.W.A., who is a Cost Accountant. All the Papers invoked a good discussion which created a very friendly atmosphere during the proceedings.

Mr. F. W. Cooper, B.Sc., M.I.Mech.E., M.I.Prod.E., the Institution's Education Officer, gave a lively and vivid summing-up to the Conference. He also made references to the training of a production engineer both in this country and the U.S.A. Mr. R. Short, Immediate Past Chairman of the Birmingham Graduate Section, expressed thanks to members of the Senior Section for the assistance given to the Graduates, also to Professor G. F. Mucklow, D.Sc., M.I.Mech.E., Department of Mechanical Engineering, for the use of the Mechanical Engineering Building at the University.

In November, the Birmingham Section will be holding a special Film Evening at the Foley College, Stourbridge, and a similar evening will be held at Oldbury Technical College in March of next year. These meetings have been arranged with a view to making the Institution's activities more widely known to people outside the main industrial areas.

Coventry

It was with particular regret that the Committee have accepted the resignations of Mr. A. Hill and Mr. W. Ellerby; Mr. Hill was for a number of years Honorary Secretary of the Coventry Section. Mr. Ellerby, a Past Chairman of the Section and a member of the Membership Committee, was present at the Annual Committee Dinner held at the Leofric Hotel, and was presented with a tankard suitably inscribed, in appreciation of the long years of service given to the Institution and the Coventry Section in particular.

The 1957/58 session opened on Monday, 16th September, with a lecture by Mr. A. J. Sephton entitled " Automation—Development of Transfer Equipment ". The lecture, supplemented by slides and a film, was attended by approximately 100 members and visitors. It was very well received and the discussion which followed both interesting and informative.

Coventry Graduate

In an endeavour to provide an interesting and varied programme of lecture meetings throughout the current session, it has been decided to break away from the conventional type of meeting, and, instead, experiment with a somewhat new idea of a practical lecture.

An illustration of this was the evening visit to the British Piston Ring Co., when members were given a talk by Mr. H. C. Blackford, M.I.Prod.E., Director, on " Changing from Batch to Flow Production ". This was immediately followed by a visit to the machine shop, where many case studies were quoted.

Another such practical lecture will be held at a stamping works in the New Year. Meanwhile, arrangements are being made for those lectures to be given by Mr. Tye, on " Dynamic Balancing " in October, and Mr. E. W. Hancock, M.B.E., on " My Experiences as President of the Institution of Production Engineers " in November.

On the social side, another Treasure Hunt was held on 29th September, thus being one of the highlights of the Coventry Graduate Section calendar.

All these activities have been very well supported by members, and it is indeed a reassuring sign of the interest shown in Graduate affairs.

Wolverhampton

Lecture meetings were not arranged during the months of July, August and September for the obvious reason, but the Committee met during July, when no fewer than 17 members attended. It was at this meeting that members accepted the resignation of Mr. C. L. Old, former Principal of the Wolverhampton and Staffordshire College of Technology. Mr. Old has been an extremely active and valuable member of the Committee since his arrival in the town six years ago, and among his many activities and offices he served as Section Chairman during the period 1954/56. He is about to take up a new appointment with the Vickers Group. As an expression of friendship and appreciation by all members of the Committee, the Chairman presented an engraved silver cigarette box to Mr. Old.

At the same meeting, Mr. M. Page was welcomed to the Committee as the newly appointed Head of the Department of Production Engineering and Management at the Wolverhampton and Staffordshire College of Technology.

The Annual Summer Outing—with apologies for the seasonal adjective—took place on Saturday, 28th September, when a party of approximately 30 members visited the Production Engineering Research Association at Melton Mowbray.

Wolverhampton Graduate

Many changes have taken place on the Section Committee. Last year's Chairman, Mr. E. J. Lownes, has transferred to the Birmingham Section because of a change of appointment. The Committee wish him every success.

Two previous Chairmen of the Committee, Mr. E. J. V. Connelly and Mr. E. Springthorpe, have become Associate Members and have been elected to the Senior Section Committee for the coming year. The previous Secretary, Mr. W. L. Pace, who has held this office for many years, has also become an Associate Member and has left the Committee.

The Section Committee has arranged a full programme of works visits and lectures covering many topics to which members and their friends will be welcome. The Annual Dinner-Dance has been arranged for November to take place at the Mount Hotel, Wolverhampton

Worcester

There have been no Section activities during the period under review, but arrangements have been made for four lectures to be held in Worcester.

In addition, two lectures have this year been arranged for Redditch. It is hoped that the Redditch area of the Section, which is numerically about equal to Worcester, will be drawn into fuller participation in Section activities.

There will also be a works visit to W. H. Allen & Sons Ltd., Pershore, in the spring.

NORTHERN REGION

Newcastle-upon-Tyne

The new Section Committee has been engaged with the preparation of the programme for the 1957/58 session which will be opened on 16th September, when Mr. C. B. Abbey will present his Chairman's Address.

It is with deepest regret that the death of Mr. T. McCulloch is recorded. Mr. McCulloch was a member of the Section Committee for a number of years and was also Section Chairman and Regional Chairman.

The Section has been visited by Mr. F. W. Cooper, Education Officer of the Institution, and it is hoped that Mr. Cooper will find it possible to visit the area at frequent intervals in the future.

It is with pleasure the Section note that Major C. E. Darlington has been elected to the Education Committee.

Tees-Side

During the past quarter the Section have lost the services of two of its oldest and most enthusiastic Committee members,

Mr. Monkhouse and Mr. Trueman, both of whom have accepted appointments in other districts. Mr. T. H. Hall, one of the founder Committee members, has been re-elected to the Section Committee.

Arrangements for the 1957/58 lecture programme have been completed; five lectures are to be given, three in Middlesbrough and two in Darlington.

NORTH MIDLANDS REGION

Regional Report

Delegates to the one-day Conference held in Lincoln on Saturday, 14th September, were welcomed by the retiring Chairman of the North Midlands Region, Mr. A. S. Johnstone, and their ladies by the Mayor of Lincoln, Councillor Mrs. G. L. Muffin.

The 60 delegates from Lincoln, Leicester, Nottingham, Derby and Peterborough, were shown around Messrs. Ruston and Hornsby's Research Laboratories, and the Works of Messrs. Ruston-Bucyrus. Lunch was served in the Spike Island Canteen, by kind invitation of Messrs. Ruston and Hornsby.

The theme of the Conference was: " The Challenge of the Atomic Age to the Production Engineer ". The principal speakers were: Mr. B. K. Barber, Wolverhampton; Mr. H. A. Adams, Warrington; and Mr. T. R. Thompson, Nottingham. The President of the Institution, The Right Hon. The Earl of Halsbury, was in the Chair.

The Ladies visited the Guildhall and inspected the civic insignia, and later were conducted around Lincoln Cathedral. As the weather was bright and sunny, the Conference was a complete success and both members and ladies complimented the organisers on the excellent arrangements.

Leicester

During the period under review the " Notes for Committee Guidance " have again been brought up-to-date by the Honorary Secretary and approved at the July Committee meeting. In these Notes the policy of the Leicester Section in conformity with the Articles of Association of the Institution have been evolved year by year. The Notes, as their title implies, are for assisting officers and Committee members in their work for the Institution. This is especially true when new officers are elected. They cover Committee elections, change of officers, procedure at lecture meetings, the Annual Dinner arrangements and many other aspects of Section activity. The Section Committee feel that the Notes have been so helpful in the past that they make an offer of them to any other Section who may be interested.

The formation of a Materials Handling Group within the Institution was discussed at considerable length by the Committee at its last meeting. After discussing many points in this connection, it was agreed to send a representative to the opening of the three-day Conference at Leamington Spa and to consider his report.

Lincoln

Owing to the holidays there has been very little activity in the Section except for a works visit to the Metal Box Co. Ltd., Sutton-in-Ashfield. Lincoln Section are very grateful to the Directors of this Company for allowing members to have a most enjoyable and interesting evening.

The Section are very grateful for the generous hospitality shown to the members in this Region by Ruston & Hornsby Limited, and Smith-Cloyton Forge Limited. The Section Committee would also like to thank Ruston-Bucyrus Ltd. for allowing members to visit their Works.

Nottingham

The Section Committee have pleasure in announcing that Mr. F. Limb, Manager of both the Nottingham and Sunderland factories of Ericsson Telephones Ltd., has been elected a Member. Also, Mr. C. T. Butler, M.I.Prod.E., Head of Engineering of the Nottingham and District Technical College, has been upgraded to full Member of the Institution of Mechanical Engineers.

Enquiries for membership continue to be received, the input of junior members of the Section being particularly encouraging.

An interesting lecture programme has been arranged and the Section look forward to a lively winter session.

NORTH WESTERN REGION

Regional Report

The first lecture of the 1957/58 session will be given in September. It will be noted with interest how attendances vary in those Sections where lecture accommodation has been changed. The North Western Regional Committee would be interested to know what experience other Regions have had at Annual General Meetings regarding attendance of members. It was noted at our last Regional Committee Meeting that within the North Western Region, attendances have been considerably poor.

Liverpool

The Section programme for the coming session consists of a series of Papers dealing with the effect of various functions on production. The functions include Design, Material Purchase, Inspection and Production Control, and the series concludes with a Brains Trust on the subjects covered by the programme. One particular feature of the series is that all the lecturers are from companies in the Liverpool and North West area.

The highlight of the session is the President's Address in December, on " Technical Training and Professional Status ", which he is giving at the Library Lecture, the annual lecture held jointly with the Liverpool Technical Libraries.

The Committee have decided that the B. A. Williams' Prize for junior members will continue on the same basis for another 12 months. The prize is awarded annually for the best essay submitted by a junior member in the Liverpool Section; but the response in recent years has been poor. Serious thought has been given by the Section Committee and the trustees of the B. A. Williams' Prize to widening the field of the competition, but for the time being the Liverpool Graduate and Student Members have been given another opportunity to show what they can do to keep the competition in its present form.

Liverpool Graduate

The first lecture of the session was given in September by H. L. Loughton, A.M.I.Prod.E., entitled " Some Machine Tool Developments " and was considered to be a most interesting lecture by all in attendance. There has also been a works visit to the Manganese Bronze Co. Ltd., Birkenhead.

Manchester

The lecture syllabus is now complete and the first lecture which takes place in September is entitled " Engineering Aspects of Automation ".

Mr. F. W. Cranmer has been elected Chairman of the Section. The Section Committee wish to record their appreciation of the services of Mr. T. Stoddart as the retiring Chairman.

Preston

The lecture programme for the winter session embraces lectures at Preston, Blackburn, Accrington, and Barrow-in-Furness, thus continuing the Section Committee's policy of taking the lecture meetings to most parts of a Section which covers a vast area. It is hoped that members will give their full support to meetings which are in their locality.

The Committee are indebted to colleges in the area concerned for so readily granting facilities for the holding of lecture meetings.

The Section Chairman, Mr. F. Grimshaw, O.B.E., is on a business tour of Australia and during his absence the duties of Section Chairman are being performed by Mr. W. L. Jones, Vice-Chairman of the Section.

The Section Committee are also to lose the services of Mr. R. J. Milburn, who is to take up an appointment with his company in their Australian factories. Mr. Milburn carries the best wishes of the Preston Section.

SCOTLAND REGION

Dundee

The Section held its first social function in August. It consisted of a conducted tour in the afternoon of the Pitlochry Turbine House, Dam and Salmon Ladder, and after dinner, the party of members and friends attended a performance at the famous

theatre in the hills. Several members of the party stayed overnight in Pitlochry and on the following day visited Braemar, Balmoral and Loch Earn, where the British Water Ski-ing Championships were being held.

The first lecture of the winter session was given by Mr. Thomas Currie, B.Sc., of the Maxam Division of the Climax Engineering Works Ltd., the subject being " Pneumatic Control of Machines". The various circuits employed were illustrated by Mr. Currie, as well as the benefits and future uses of air and air hydraulic equipment. The discussion which followed showed the awareness of Section members to developments in this field.

SOUTHERN REGION

Reading

The Section have arranged another interesting programme of lectures following its proved practice of holding them at three different towns, namely, Reading, Basingstoke and Staines.

The Committee look forward to good support from the Section.

A larger number of applications for membership have been dealt with this year.

Southampton

Arrangements for the programme for the coming session have now been completed. The first meeting is to be held in October. Plans are at present being made for the Sixth Annual Aircraft Conference to be held in January, 1958.

The Section Dinner-Dance postponed in March, 1957, is now to take place at the Polygon Hotel, Southampton, in November, 1957. This is always a very attractive affair and has now become an annual event in the local social calendar.

SOUTH EASTERN REGION

London

Arrangements for a full lecture programme for 1957/58 are complete with the exception of two that are taking place at Brighton. There will be six lectures at the Royal Empire Society and two at Croydon. It is hoped to conclude the programme in the very near future with the details of the Brighton Lecture Meetings.

Draft Terms of Reference have been submitted to the Brighton Sub-Committee and are now under discussion and will be agreed shortly.

The London Section will be holding its Annual Section Stag Dinner in February, 1958, and it is hoped that the number of guests attending will be even greater than this year, which in itself was a record. The Section Committee are very pleased to learn that the President, Lord Halsbury, will be attending this function.

Luton

The Section has to report that a series of related lectures has been arranged for 1957/58 centred around the theme " New Tools for the Production Engineer ". The Sub-Committee appointed to arrange the programme had an arduous task, and it is hoped that their efforts will be rewarded by a good response in the matter of attendance at lecture meetings.

The custom of holding joint lecture meetings with the Eastern Branch of I.Mech.E. has been continued, and it is hoped that it will be a permanent feature of our programme.

During June, the Section had the pleasure of meeting the Institution's Education Officer, Mr. F. W. Cooper. Valuable advice and guidance was given to the Section Committee regarding " borderline " applications for transfer and membership.

Rochester

The winter session of lecture meetings is due to commence in October.

In November, and for the first time, the Senior and Graduate Sections are holding a joint meeting, when the Paper will be on: " The Application of Radioactive Isotopes in Industry ". The Section Committee have great hopes that this joint meeting will not only be beneficial to all who attend, but may point the way to combined meetings with other professional bodies.

Rochester Graduate

The Section programme planned for the 1957/58 session comprises four lecture meetings and two works visits.

Arrangements for the programme are well in hand.

South Essex

The first meeting of the 1957/58 winter session will be held in October, when Sir Gordon Russell, Director of the Council of Industrial Design, will present a Paper " Pride in Workmanship ".

The Section Committee at their September meeting elected the Section Representative to the Materials Handling Group Committee.

Western

The Section is extremely honoured by the fact that once again the Viscount Nuffield Paper is to be presented in Bristol. The Section Committee are also delighted that such a renowned person as Lord Hives is to be the speaker.

The Section are still following the policy of a small number of well-chosen lecturers rather than attempting to fill a programme with a meeting every three or four weeks.

The Committee are also very happy to continue in association with the Royal Aeronautical Society and are looking forward to the joint meeting in December at which Mr. John Sargrove is to talk on: " The Emergence of Automation as an Evolutionary Process ".

The Section Committee's efforts with Bristol University appear to be bearing some fruit as they have now arranged an extra course of some 20 lectures on " Production Engineering ". In this respect it is interesting to note that they have obtained the assistance of the Department of Engineering Production in the University of Birmingham.

Members in the Western district are becoming increasingly active. There are now two on the Committee and due to their efforts two meetings have been arranged at Weston-super-Mare during next session, the first of which takes place in October.

WALES REGION

Regional Report

The Region are very sorry to record the resignation from his duties as Honorary Secretary to the Region and Swansea Section of Mr. H. P. Sanderson, who has taken up a new appointment with his Company in the Midlands area.

The preparations for a one-day Conference to be held in April, 1958, are going forward most satisfactorily and it is hoped that details will be finalised in the near future.

In view of the success of the last works visit of Regional members, it is hoped to arrange a further visit including members' ladies, the gentlemen visiting one factory whilst the ladies visit a factory of feminine interest in the vicinity.

Cardiff

During the summer recess there has been considerable activity in completing the lecture programme for the forthcoming winter session. The Section programme over the past few years has been very successful and the Section Committee's efforts have been directed at maintaining the quality and interest of lectures. It is felt by the Committee that the lectures selected will uphold that high standard of past years.

Efforts have been made to form a Graduate Section but membership is so widely dispersed that it has not been found possible to complete this project. The Committee hope that Graduate and Student members will attend lectures whenever they have an occasion to visit Cardiff.

Discussions have taken place on the Material Utilisation Working Groups and several of the Committee have offered to supply case studies for consideration.

Swansea

The Swansea Section have again been active in helping in the preparation of the one-day Conference to be held in April, 1958. The complete calendar of lectures for the winter session commencing 24th September has been completed, with a most interesting series of lectures, the opening lecture being a joint meeting with the British Productivity Council—West Wales.

SECTIONS OUTSIDE THE UNITED KINGDOM

Adelaide

Attendances at meetings have been at a satisfactory level ranging from 20 to 40.

The Section visited a bookbinding and offset printing works and have had lectures on: " Group Dynamics in Industrial Education ", " The Theory of Corrosion and its Prevention " and " Glass Technology Applied to Electronic Tube Manufacture ".

Calcutta

One lecture meeting was held in July, when a talk entitled " Testing and Development of Activity Sampling in Indian Industries " was given by Mr. S. K. Basu, Grad.I.Prod. E.,who is lecturer in Mechanical Engineering at the Production Technology and Industrial Engineering Indian Institute of Technology

Two Section Committee meetings were held during the months of July and August, 1957, and another is due to be held in September.

Melbourne

The Melbourne Section has held three meetings and one works visit this quarter.

At the June meeting 82 members and visitors attended to hear a Paper entitled " Human Relations and Automation " presented by Mr. A. T. Chandler, B.A.(Hons.Psych.). Mr. Chandler spoke on how the impact of automation on operators and management groups will affect production engineers and logical steps that may be taken to assist in their solution.

At the July meeting a Paper was presented by Mr. C. L. Faudell, entitled " Television as an Aid to Industry ". Mr. Faudell is Technical Director of Television Engineering Pty. Ltd., a subsidiary of Electronic Industries Ltd., and is a world authority on television. His Paper covered television applications apart from broadcasting. With the aid of cameras and equipment he demonstrated some of the industrial uses where television can assist production engineers.

At a special meeting held at the University of Melbourne during July, members were invited to attend a talk by Professor P. L. Henderson entitled " Some Observations on Production Engineering and Management Education Abroad ".

At the August meeting, a Paper was presented by Mr. J. H. McQueen, A.M.I.E.(Aust.), entitled " Rubber in Industry—Design Principles ". Mr. McQueen is Field Engineer for the Industrial Division of Dunlop Rubber Australia Ltd. He spoke on new applications of rubber and synthetics to mechanical equipment and products.

Two days later a works visit was made to Dunlop Rubber Australia Ltd., where 20 members were shown tyre manufacture and various methods used in the processing and moulding of rubber.

The Melbourne Section, on behalf of the Australian Council, is now organising the presentation of the James N. Kirby Paper, which will be given in Melbourne during September by Mr. Walter Scott, Governing Director of W. D. Scott & Co. Mr. Scott has chosen as his subject: " Operation Future—The Engineer in a Changing World ". A full report of this meeting will be given next quarter.

Melbourne Graduate

During the period under review this Section has held two works visits. The first being to Martin and King Ltd. This Company assembles Volkswagen cars, also passenger railway carriages for the Victorian Railways. The second visit was to the works of Australian Paper Manufacturers who manufacture brown paper, general wrapping paper and cardboard of various qualities. A very clear insight was gained on this visit into the manufacturing techniques employed in the production of all forms of paper.

In July, 1957, the Section had a combined lecture with the Institution of Engineers—Australia, when Mr. W. G. Medely gave a lecture on " Automation " which was of very great interest and very well presented.

New Zealand

Section Committee meetings were held during this quarter in the months of June and August.

In July, a well attended meeting of members and their friends were favoured with a talk by Mr. D. James, of the Gilbert Lodge Organisation. His subject was " The Gleason System of Gear Cutting and the Machines for Producing and Testing Gears ". This proved most interesting and instructive.

Mr. James had only recently returned to Australia from the Gleason Works in America and, was, therefore, conversant with the latest practices in this field. A lively and informative discussion followed the talk.

South Africa

On 4th April a very interesting film evening was held, in which the films, " The History of the English Steel Corporation ", and " Dust Suppression in Industry " produced in conjunction with the Home Office and Industry in Great Britain, were shown. The film on the history of the English Steel Corporation is an extremely well-produced one.

In May, the Senior Inspector of Factories gave a lecture on " The Administration of the Factories Act and Regulations ". This lecture and the following discussion proved very helpful to members in assisting them with the interpretation of various aspects of the Factories Act. Also during May, members visited the South African Railway Workshops at Koedoespoort which is situated just outside Pretoria. This was very well attended and members saw the working of what is probably one of the best equipped workshops in South Africa.

The General Meeting in June took the form of a lecture on " Powder Metallurgy ". The paper was prepared by Mr. G. R. Bell of Powder Metallurgy Ltd., England, and very ably read to members by Mr. L. Marucchi, a senior engineer in the employ of a local company associated with Powder Metallurgy Ltd.

A film evening, to which ladies and friends were invited was convened for July. A mixed programme of technical films and general interest films was shown, as follows: " Machining of Metals "; " Livingstone on the Zambesi "; " The Dutch T.T. Races "; " T.T. Races on the Isle of Man ". This meeting was very well attended and the motor cycle enthusiasts were very thrilled with the film on the T.T. races.

As is usual in August, the Annual General Meeting and Annual Dinner were held at the Wanders Club in the Northern Suburbs of Johannesburg. About 100 members and their guests attended. This always successful function, at which Mr. Gideon Roos, the Regional Director of the S.A. Broadcasting Corporation and Dr. Knoll, a leading production engineer in South Africa, were the guest speakers, was a huge success.

Also during August a works visit was convened. The company visited was Messrs. Dorman Long (Afr.) Limited one of the biggest railway truck manufacturers in South Africa.

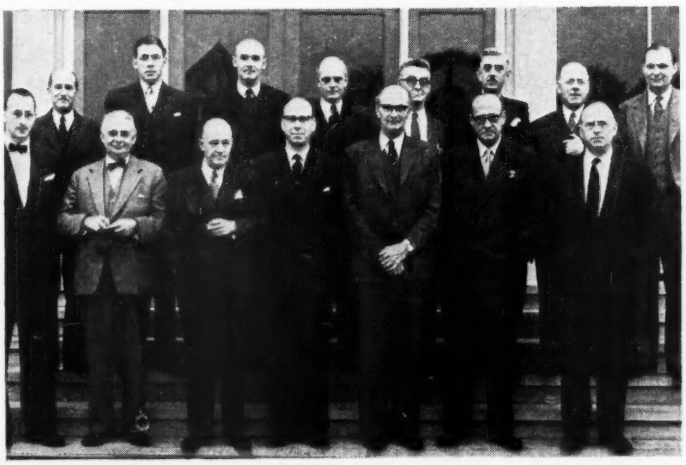
On 5th September there was a presentation of a Paper " Industrial Standardisation " by Mr. J. W. Swardt of the South African Bureau of Standards.

Sydney

Monthly lectures have maintained a high level of technical and general interest.

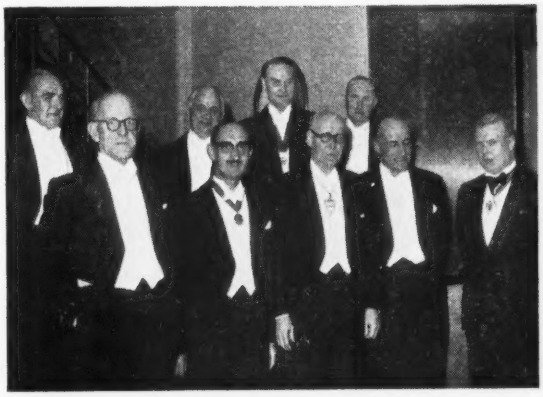
In July, Mr. Noel Hicks, General Manager of Electrical Control & Engineering Ltd., spoke on " Electric Variable Speed Controls ". The August Paper, " How the Production Engineer can be Helped by Research ", was given by Mr. C. A. Gladman, Senior Principal Research Officer, S.S.I.R.O., Division of Metrology. Although attendance at meetings during the winter months has been disappointing, the September lecture on " The Production of Small Arms " by Mr. R. J. Barry, A.M.I.Prod.E., Assistant Manager (Planning), of the Small Arms Factory, Lithgow, was well attended.

A Residential Conference has been arranged for October at the Brighton Hotel, Kiama, and a programme of addresses and discussions has been drawn up on the subject: " Production Planning and Control ".



VISIT TO PERA. On 8th October last, the Council of the Institution paid an official visit to the Production Engineering Research Association at Melton Mowbray, where they were able to view the recently-completed Research Laboratories. In this group, photographed during the visit, are (front, left to right) Dr. F. Galloway, PERA's Director of Research; Mr. G. R. Pryor, Vice-President of the Institution; Mr. E. Percy Edwards; Mr. E. Gilberthorpe; the President of the Institution, The Rt. Hon. The Earl of Halsbury; Sir Lionel Kearns, Chairman of PERA Council; Mr. H. G. Gregory, Chairman of the Institution's Council. In the back row (from left) are I.Prod.E. Council Members Messrs. H. Stafford, A. Betts Brown, R. S. Clark, F. J. Everest, L. Pitteway, H. B. Harris, J. H. Winskill and W. F. S. Woodford (Institution Secretary).

SHEFFIELD SECTION DINNER. This took place at the Grand Hotel, Sheffield, on 14th October, 1957, and was again a most successful function. The chief guest was Mr. W. F. Cartwright, Assistant Managing Director of the Steel Company of Wales. In the photograph (right) are (front, from left) Mr. J. E. Hill, Vice President of the Institution; Mr. J. R. Widdowson, Sheffield Section Chairman; The Master Cutler, Sir Frederick Pickworth; Mr. Cartwright; and the President of the Sheffield Chamber of Commerce, Mr. D. J. Haggie. In the back row are Mr. W. Lyth, Editor of the "Sheffield Telegraph"; Mr. G. R. Pryor; Mr. W. A. Jenkins, J.P.; and Mr. W. A. Hannaby, Chairman of the Halifax and Huddersfield Section.



DIARY FOR 1958

2nd and 3rd January	**Sixth Annual Aircraft Production Conference, Southampton.** (See also Supplement to this Journal.)
6th February ...	**The 1957 Viscount Nuffield Paper,** to be presented at the University of Bristol. Speaker: **Lord Hives.** Subject: **"Technical Education for Production Engineers".**
24th March	**The 1957 George Bray Memorial Lecture,** to be presented at the University of Leeds. Speaker: **Dr. V. E. Yarsley.** Subject: **"The Fabrication of Plastics".**
9th and 10th April ...	Conference on **"Compressed Air in Industry",** Camborne, Cornwall.
12th - 21st May ...	**Production Conference and Exhibition,** Olympia.
27th - 31st August ...	**Annual Summer School,** Ashorne Hill, Warwickshire.
29th October	**Annual Dinner of the Institution,** Dorchester Hotel, London.

news of members

Mr. G. L. Brough, Member, has taken up an appointment as General Superintendent of The Canadian Dredge & Dock Company Limited, Ontario, Canada.

Mr. A. W. Christy, Member, has recently been appointed Sales Manager of Geo. W. King Limited. Mr. Christy was previously Senior Technical Sales Representative, and has been with the Company for 15 years.

Mr. P. H. W. Everitt, Member, has been appointed a Director of Fuller Electric Limited, one of the Companies in the Brush Group. Mr. Everitt is Chairman of the Institution's South Essex Section, and also serves on the Research Committee.

Mr. R. E. Harvey, Member, Director and General Manager of Short Bros. & Harland, Belfast, has been appointed a deputy managing director.

Mr. R. E. Leakey, Member, has been appointed Chief Manufacturing Engineer and a special director of Powers-Samas Accounting Machines Limited. Mr. Leakey serves on the London Section Committee and is a past Chairman of the Section.

Mr. M. R. Barton, Associate Member, has recently taken up an appointment as a Senior Planning Engineer with The English Electric Co. Limited, at their Stevenage Works.

Mr. C. C. Bates, Associate Member, is representing the Institution of Production Engineers on the British National Committee for Non-Destructive Testing at the Second International Conference on Non-Destructive Testing, which is taking place in Chicago this month. Mr. Bates is Technical Director of Welding Supervision, Limited.

Mr. S. Bhattacharya, Associate Member, formerly of the Technical Training Department of the Government of Orissa, has now left Government service and has joined Messrs. Saxby & Farmer (India) Private Limited, Calcutta, as their Training Superintendent.

Major C. E. E. Bracken, Associate Member, will shortly be returning to the United Kingdom to take up the appointment of Workshop Officer in 21 Command Workshop R.E.M.E., Burscough, Lancs.

Mr. L. L. Chadderton, Associate Member, has relinquished his position with Messrs. C. W. F. Hamilton & Co. Limited, and has now taken up an appointment as a Designer/Sales Engineer with Messrs. Campion and Irving Limited, Christchurch, New Zealand.

Mr. R. W. Crow, Associate Member, has recently left Bristol Aircraft Limited (Weston Division), in order to take up a position as a Planning Engineer with British European Airways, London Airport.

Mr. E. E. Hempsall, Associate Member, formerly Establishment Manager, Renold Chains Limited, Coventry, has now been appointed Central Production Manager, Renold Chains Limited, Manchester.

Mr. Thomas P. Keenan, Associate Member, has taken up an appointment as Tool Engineer "A" with The Boeing Airplane Company, Seattle, Washington, U.S.A.

Mr. D. McGrotty, Associate Member, is now an Industrial Engineer with Canadian Westinghouse Co. Limited, London, Ontario.

Mr. J. Pearson, Associate Member, is now Engineering Superintendent at Messrs. Tickford Limited, Newport Pagnell, Bucks.

Mr. G. D. Shaw, Associate Member, has relinquished his position as Senior Designer with The Metal Box Company Limited, and has been appointed Production Superintendent of The Kiwi Polish Co. Limited.

Mr. D. J. Sinclair, Associate Member, until recently Workshops Manager (Engineer II) at the Royal Radar Establishment, Malvern, has now been promoted Principal Inspecting Officer (Engineer I) in the Gauges Department of the Directorate of Inspection of Armaments, London.

Mr. B. J. Stedman, Associate Member, of The Metal Box Company of India Limited, Bombay, will shortly be leaving India to take up an appointment in England.

Mr. G. Thompson, Associate Member, has recently been appointed Works Manager of Messrs. Adcock & Shipley Limited, Leicester.

Mr. P. H. C. Waddington, Associate Member, has recently transferred from the Stafford Works of The English Electric Company Limited, where he was Chief of Switchgear Spares Section, to take up a position as Chief of the Standardisation Section, G.W. Division of the Company.

Mr. E. J. Ayres, Graduate, has left Messrs. W. D. & H. O. Wills, and has now taken up an appointment with General Motors (N.Z.) Limited, Petone, in the Vehicle Engineering Division (Methods and Planning Section.)

Mr. R. G. Clarke, Graduate, has relinquished his position as Contract Engineeer with Fisher & Ludlow Limited in order to take up an appointment with Mardy Spicer Limited as a Process Planning & Methods Engineer.

Mr. J. A. Harris, Graduate, has now taken up a position as Work Study Engineer with M. W. M. (London) Limited.

Mr. K. L. Morgan, Graduate, has recently been appointed Technical Salesman at Messrs. Thompson Bros. Bilston) Limited, Bradley, Bilston.

Mr. J. A. Prettyman, Graduate, has completed his National Service in the Engineering Branch of the Fleet Air Arm, and is now a Management Trainee with Brush Electrical Engineering Co. Limited, Loughborough, Leics.

Mr. N. P. Spencer, Graduate, has relinquished his position of Jig and Tool Designer with Messrs. H. Pickersgill & Company in order to take up an appointment as Design Engineer with Messrs. Morgan & Co., Leeds.

Mr. F. E. Taylor, Graduate, has been promoted to Engineer at the National Coal Board's Central Engineering Establishment, near Burton-on-Trent.

Hazleton Memorial Library

REVIEWS

" Thinking by Machine : a Study of Cybernetics " by Pierre de Latil. Translated from the French by Y. M. Golla. *London, Sidgwick and Jackson,* 1956. (*French edition* 1953). 353 *pages. Illustrated. Diagrams.* 45s.

Writing under such a title as Cybernetics is an extremely exacting task; the field is so broad that it is difficult to introduce all the facets of the subject without getting so involved in one's own specialisation that the output is incomprehensible to everyone but a fellow specialist.

M. de Latil has tackled his task conscientiously and produced a worthwhile volume that will go a long way towards breaking down the artificial barriers created by the deep study of one subject.

In the space of some three hundred pages the author has succeeded in introducing a multitude of specialist studies such as physiology, philosophy, neurology, engineering, psychology and mathematics, and so linking them that their juxtaposition seems quite natural.

In the hierarchy of cybernetic volumes this book falls between Norbert Wiener's classic work "Cybernetics" and Wladyslaw Sluckin's book "Minds and Machines".

The chapters describing the experiments conducted by such personalities as Grey Walter and Ross Ashby are particularly clear, while the section devoted to what the author describes as " The Miracle of Feedback " helps considerably to illustrate the common link between the varied sciences. If any criticism can be levelled at the section on feedback it is that the author is so impressed by "The Miracle" that he has confused its essential simplicity with a bewildering number of examples. The latter portion of the book from Chapter XI onwards is extremely enlightening, and the "tricks" used in calculating machine design are well illustrated.

This volume is well worth the effort expended in reading it and contains something of interest for the intelligent layman and the erudite practitioner, its worth as a popular exposition of Cybernetics is somewhat doubtful as it contains so much terminology the precise meaning of which is the knowledge of so few. In this respect it is felt that a glossary of technical terms would be a great asset in a book of this type, as so much of the jargon can only be understood after reference to technical dictionaries dealing with the subject under consideration, and cannot be located in standard English Dictionaries.

J.I.

" Introduction to Printed Circuits" by Robert L. Swiggett. *New York, John F. Rider; London, Chapman and Hall.* 1956. 101 *pages. Illustrated. Diagrams.* $2.70 (21s.).

This book, as its title suggests, is directed primarily to the technician and technologist who is investigating printed circuits for the first time. No very detailed treatment can be given in a book of its size, but the author has managed to describe the main printed circuit systems in use today. Etched circuits are given the fullest treatment, which covers the raw materials, methods of manufacture of the copper laminate, printing, etching and so forth. This section contains several useful tables on electro-plating of circuits; current carrying capacity of conductors, and some typical characteristics of the laminates used.

Anyone with knowledge of the basic principles of printed circuits can derive much useful information from close study of the many excellent photographs. It is a pity that their task is made unnecessarily difficult by the fact that these illustrations, as in so many otherwise excellently produced books, are often out of step with the text. The chapter on assembly systems has many excellent illustrations of the type of equipment used, and should interest anybody confronted by assembly problems. Little has been written on the servicing of printed circuits. The last chapter of the book, although short, gives a fairly thorough treatment of this very important subject.

The book may seem expensive relative to its length (probably because of its American origin), but it covers a large field in an easy manner, and is, in the reviewer's opinion, well worth the money to anybody interested.

I.K.

Journal Contents

Volume 36, 1957

January

	Page
"The Supply of Students for Technological Education" by Dr. J. Topping, M.Sc., D.I.C., F.Inst.P.	1
The 1956 *Viscount Nuffield Paper*	
"Thinking Machines" by Dr. W. Grey Walter	4
Report and Discussion	12
Midlands Region Annual Conference	17 - 24
"An Outline of B.M.C. Development in the Field of Automation" by H. J. Graves	18
"Design and Manufacturing Problems" by H. W. Holbeche	20
"An Outline of Processes, Assemblies and Material Movement" by F. Griffiths	23
"The Use of Carbon Dioxide in the Engineering Industry" by T. B. Philip, B.Sc., A.R.C.S., M.I.Chem.E.	25
"The Practice and Principles of Tube Manipulation" by T. H. Wilkes, A.M.I.Prod.E.	32
"High Production Tooling for Induction Heating" by C. E. Glick and P. N. Sorenson	40
"Productivity and the Second Industrial Revolution"	49
PERA Quarterly Newsletter	51
Materials Handling — Case Study No. 10	52
Institution Notes	54
News of Members	55
Notice of Annual General Meeting — 31st January, 1957	56
Minutes of Annual General Meeting — 26th January, 1956	56
Report on Election of Members to Council, 1956 - 57	57
Report of Council—1st July, 1955 to 30th June, 1956	58
Hazleton Memorial Library — Reviews	65
Balance Sheet and Accounts for the Year ended 30th June, 1956	66

February

"The Challenge of the Age" by C. T. Brunner	73
The 1956 *Sir Alfred Herbert Paper*	
"The Development of Technological Education in Europe, America and England" by Dr. B. V. Bowden, M.A., M.I.E.E.	75
Report and Discussion	89
Communications	95
"Non-Destructive Testing and the Production Engineer" by W. G. Cook, B.Sc.	97
"The Pneumatic Gauging Technique in its Application to Dimensional Measurement" by Dr. J. C. Evans. (A Communication from the National Physical Laboratory.)	110
"Practical Marginal Costing" by W. E. Harrison, F.C.W.A., A.M.I.I.A.	121
"Metal Cleaning and Finishing by the Airless Abrasive Blasting Process" by F. W. Pedrotty	128
News of Members	136
Education Discussion Group—Midland Centre Report	137
Hazleton Memorial Library — Periodicals Currently Received	138

March

The 1957 *Conference on Aircraft Production, Southampton, 8th - 9th January*	
Addresses at Opening Luncheon	141
Conference Programme	145
Session I (The Lord Sempill Paper)	
"Concentration of Aircraft Development" by Karl Frydag	146
Report and Discussion	151
Session II	
"The Fatigue of Aircraft" by Major P. L. Teed, A.R.S.M., M.I.M.M., F.R.Ae.S., F.I.M., F.R.S.A.	154
Report and Discussion	165
Session III	
"Numerical Control of Machine Tools in Aircraft Manufacture" by O. S. Puckle, M.B.E., M.I.E.E.	169
Report and Discussion	187
The 1956 *Lord Austin Prize Essay*	
"Welding Distortion Problems Encountered in the Gas Turbine Industry" by S. A. Onions, Grad.I.Prod.E., Grad.Inst.W.	193
The Delft Report	200
1957 Schofield Travel Scholarships	201
PERA Newsletter	202
Report of the Meeting of Council—31st January, 1957	203
Report of the Annual General Meeting—31st January, 1957	206
Elections and Transfers	207
Extracts from Region and Section Reports	209
Institution Notes	214
News of Members	215

April

"What is Meant by Practical Training?" by Sir Walter Puckey, M.I.Prod.E., F.I.I.A.	217
The 1957 *Conference on Aircraft Production, Southampton, 8th - 9th January*	
Conference Programme	223
Session IV	
"The Hot Forming, Assembling and Service Applications of Magnesium Alloys" by R. G. Wilkinson, B.Sc.	224
"Recent Advances in the Application of Resistance Welding to Airframe Construction" by N. K. Gardner, B.Sc.(Eng.), A.F.R.Ae.S.	238
"Contour Etching" by A. W. Sheppard	253
Report and Discussion	262
Conference Summing-Up by H. G. Gregory, M.I.Prod.E., Chairman of Council	273
The 1956 *Schofield Scholarship Paper*	
"Production Engineering as a Training for Management" by H. Scholes, M.A., Grad.I.Prod.E.	274
"The Factories Acts—How They Affect Engineering Establishments" by Sir George Barnett, H.M. Chief Inspector of Factories	279
Correspondence	284
Notice of Council Elections, 1957 - 1958	285
Materials Handling — Case Study No. 11	286
Institution Notes	288
Hazleton Memorial Library—Reviews and Additions	289

May

"The Challenge of the Age" by Walter Scott	293
The 1956 *George Bray Memorial Lecture*	
"The Scope for Operational Research in Industry" by Stafford Beer	298

Page

Report and Discussion 321
Correspondence 331
"Automation — Verbal Fiction, Psychological Reality" by The Rt. Hon. The Earl of Halsbury, F.R.I.C. 333
"The Impact of the Production Engineer upon the Structure of Work and Payment in Industry" by Dr. Elliott Jaques 344
News of Members 351
Hazleton Memorial Library — Additions 353

June

"The Challenge of the Age" by Charles E. Bedaux 355
"The National Need for Technologists — Can We Meet the Demand?" by Sir Roy Fedden, M.B.E., D.Sc., Hon.F.R.Ae.S., M.I.Mech.E., F.R.S.A., Hon.F.I.A.S., Hon.F.S.A.W.E. ... 360
"People in Industry — The Changing Pattern of Industrial Society" by E. W. Hancock, M.B.E., M.I.Mech.E., Hon.M.I.Prod.E., F.I.I.A., F.R.S.A., President of the Institution ... 365
Discussion 374
"Some Human Aspects of Inspection" by R. M. McKenzie, M.C., M.A. and D. S. Pugh, M.A. 378
Communications 387
"The Recirculating Hot Air Oven Applied to Stove Enamelling." A Thesis by D. Liptrot, A.M.I.Prod.E., A.F.R.Ae.S. 389
"Apprentice Training in Small Firms" by B. Whittaker, B.Sc.(Eng.), A.M.I.W., A.M.I.Prod.E., A.M.I.Mech.E. 396
Report of the Meeting of Council—25th April, 1957 398
Elections and Transfers 400
Formation of Materials Handling Group 402
Extracts from Region and Section Reports 403
News of Members 408
Hazleton Memorial Library — Additions 410
Institution Records 411

July

A Presidential Message from The Right Hon. The Earl of Halsbury, F.R.I.C., F.Inst.P., M.I.Prod.E. 413
Harrogate Conference Papers
"The Cost of Automation" by F. T. Hunter, F.C.A., F.C.W.A. 416
"Computer-assisted Production Control" by W. J. Kease 423
"What New Skills Will the Future Demand?" by C. B. Gibbs, B.Sc. 442
"The Analysis of Industrial Behaviour" by Professor R. W. Revans, Ph.D., B.Sc. 448
Report of the Standards Officers' Conference — May, 1957 458
"Education and the Production Engineer." A progress report from the Chairman of the Education Committee 460
The Technical and Scientific Register 462
PERA Newsletter 464
Correspondence 465
The Principal Officers, 1957 - 1958 466
Sir Alfred Herbert, K.B.E. — An Appreciation ... 467
Institution Notes 468
News of Members 471
Hazleton Memorial Library—Reviews and Additions 472

August

The Harrogate Conference
First Plenary Session, 1st July 475
"The Administration of Modern Production" by The Right Hon. The Earl of Halsbury, F.R.I.C., F.Inst.P., M.I.Prod.E., President of the Institution 480

Page

"The Effect of Automation on Management Organisational Principles and Practices" by Dr. Lillian Gilbreth 488
"Product Design for Automated Production" by D. L. Johnston, B.Sc.(Eng.), A.M.I.E.E., M.S.I.A. 494
"Data Processing Systems as an Aid to Management" by N. D. Hill, B.Sc., A.Inst.P. 510
"High Speed Production from Bar Material" by R. Jackson, A.M.I.Prod.E. 515
Material Utilisation Sub-Committee — Notes for Guidance in the Preparation of Case Studies 524
Institution Notes 532
The 1957 Sir Alfred Herbert Paper 533
Hazleton Memorial Library—Reviews and Additions 534

September

"The Challenge of the Age" by Dr. Ing. Erich Mittelsten Scheid 535
Harrogate Conference Papers
"Control and Communication — A Management Concept of Cybernetics" by Miss Joan Woodward, M.A. 539
"Scheduling for Batch Production" by Dr. S. Eilon, A.M.I.Prod.E. 549
"Simplification and Standardisation for Automation" by E. G. Brisch, M.I.Mech.E., M.I.Prod.E., F.R.S.A. and R. S. Geoghegan, T.D., M.I.Mech.E., M.I.Prod.E., M.I.W.M. ... 571
"Master and Man — A New Look at an Age-old Relationship" by E. C. Gordon England, F.R.Ae.S., F.I.M.T., M.I.Prod.E., F.I.I.A. ... 583
Standing Committees — 1957 - 1958 592
"New Techniques in Sheet Metal Forming" by J. A. Grainger, A.M.I.Mech.E., M.I.Prod.E., A.M.I.I.A. 593
Report of the Meeting of Council — 25th July, 1957 607
Elections and Transfers 609
Extracts from Region and Section Reports 611
Report of the Eighth Annual Summer School ... 615
PERA Newsletter 617
News of Members 618
Hazleton Memorial Library—Reviews and Additions 619

October

Harrogate Conference Papers
"What About the Small Firm?" by E. W. Hancock, M.B.E., M.I.Mech.E., Hon.M.I.Prod.E., F.I.I.A., F.R.S.A. 621
"Machine Tools of the Future" by Denis Player, M.I.Prod.E., F.Inst.D., Mem.A.S.T.E. and W. K. Temple, A.M.I.Mech.E., A.M.I.Prod.E. 628
"Transfer Pressing" by Gordon M. Sommer and Robert H. Barlow 646
"The Application of Unit Heads and Special Machines as an Aid to Batch Production" by G. H. Asbridge 659
"Working Together With Other Men" by Professor A. F. Burstall, D.Sc., Ph.D., M.I.Mech.E. ... 663
News of Members 669
Hazleton Memorial Library—Reviews and Additions 671

November

"Automatic Production — Change and Control" 675
Harrogate Conference Papers
"The Control of Quality in Automatic Production" by John Loxham, C.G.I.A., M.I.Mech.E., M.I.Prod.E. 676
"The Challenge of the 'Dip.Tech.'" by Sir Walter Puckey, M.I.Prod.E., F.I.I.A. 699
Case Studies
"Bread" — A Study in Progressive Development — by John A. Sargrove, Dip.M.E., M.I.Prod.E., M.I.E.E., M.Brit.I.R.E. 705

	Page
"Beds" — And Their Making — by Anthony Lebus	715
"Boats" by C. G. James, O.B.E.(Mil.), A.F.R.Ae.S.	719
"Beer" by G. W. Barton, A.M.I.Mech.E.	727
"Education for Management — Are We Falling Behind?" by G. W. Pitt, A.M.I.Prod.E., M.B.A.(Chicago), Dip.Econ. and Pol.Sc.(Oxon.)	734
News of Members	739
Diary for 1958	740
Hazleton Memorial Library — Reviews and Additions	741
December	
The Annual Dinner, 1957. Addresses by Sir John Maud, G.C.B., C.B.E., and The Rt. Hon. The Earl of Halsbury	743
"Compressed Air — A User's Experience" by John Smedley and W. G. Wood	749
"Some Aspects of Automation" by A. L. Stuchbery, M.I.Prod.E., M.I.Mech.E.	755
"Tooling for Precision Presswork" by J. Galway	760
"Measuring and Forecasting Cost Data in Highly Variable Production" by A. G. Thompson, B.Sc., A.M.I.C.E.	771
Report of the Meeting of Council—31st October, 1957	786
Elections and Transfers	788
Extracts from Region and Section Reports	790
Institution Notes	795
News of Members	796
Hazleton Memorial Library — Reviews	797
Journal Contents, Volume 36, 1957	798
Index to Papers, 1957	800

Index to Papers 1957

	Pages		Pages		Pages
January	1 - 72	May	293 - 354	September	535 - 620
February	73 - 140	June	355 - 412	October	621 - 674
March	141 - 216	July	413 - 474	November	675 - 742
April	217 - 292	August	475 - 534	December	743 - 804

AUTHOR INDEX TO PAPERS PUBLISHED

Asbridge, G. H. "The Application of Unit Heads and Special Machines as an Aid to Batch Production." 659

Barlow, Robert H. "Transfer Pressing" (with Gordon M. Sommer). 646

Barnett, George. "The Factories Acts — How They Affect Engineering Establishments." 279

Barton, G. W. "Beer" (Case Study). 727

Bowden, B. V. "The Development of Technological Education in Europe, America and England." ... 75

Brisch, E. G. "Simplification and Standardisation for Automation" (with R. S. Geoghegan). 571

Brunner, C. T. "The Challenge of the Age." ... 73

Burstall, A. F. "Working Together With Other Men." 663

Cook, W. G. "Non-Destructive Testing and the Production Engineer." 97

Eilon, S. "Scheduling for Batch Production." ... 549

England, E. C. Gordon. "Master and Man — A New Look at an Age-old Relationship." ... 583

Evans, J. C. "The Pneumatic Gauging Technique in its Application to Dimensional Measurement." ... 110

Fedden, Roy. "The National Need for Technologists — Can We Meet the Demand?" 360

Frydag, Karl. "Concentration of Aircraft Development." 146

Galway, J. "Tooling for Precision Presswork" ... 760

Gardner, N. K. "Recent Advances in the Application of Resistance Welding to Airframe Construction." 238

Geoghegan, R. S. "Simplification and Standardisation for Automation" (with E. G. Brisch). 571

Gibbs, C. B. "What New Skills Will the Future Demand?" 442

Gilbreth, Lillian M. "The Effect of Automation on Management Organisational Principles and Practices." 488

Glick, C. E. "High Production Tooling for Induction Heating" (with P. N. Sorenson). 40

Grainger, John A. "New Techniques in Sheet Metal Forming." 593

Graves, H. J. "An Outline of B.M.C. Development in the Field of Automation." 18

Griffiths, F. "An Outline of Processes, Assemblies and Material Movement." 23

Halsbury, J. A. H. Giffard, Third Earl of. "The Administration of Modern Production." ... 480

"Automation — Verbal Fiction, Psychological Reality." 333

Presidential Message 413

Hancock, E. W.

"People in Industry — the Changing Pattern of Industrial Society." 365

"What About the Small Firm?" 621

Hill, N. D. "Data Processing Systems as an Aid to Management." 510

Holbeche, H. W. "Design and Manufacturing Problems." 20

Harrison, W. E. "Practical Marginal Costing." ... 121

Hunter, F. T. "The Cost of Automation." ... 416

Jackson, R. "High Speed Production from Bar Material." 515

Jaques, Elliott. "The Impact of the Production Engineer Upon the Structure of Work and Payment in Industry." 344

James, C. G. "Boats" (Case Study). 719

Johnston, D. L. "Product Design for Automated Production." 494

Kease, W. J. "Computer-assisted Production Control." 423

Lebus, Anthony. "Beds" — And Their Making (Case Study). 715

Liptrot, D. "The Recirculating Hot Air Oven Applied to Stove Enamelling." 389

Loxham, John. "The Control of Quality in Automatic Production." 676

McKenzie, R. "Some Human Aspects of Inspection" (with D. S. Pugh). 378

Materials Handling Sub-Committee.

Case Study No. 10 — Assembly of Plastics Door Furniture 52

Case Study No. 11 — Handling of Refractories ... 286

Ministry of Labour and National Service. "The Technical and Scientific Register." 462

Onions, S. A. "Welding Distortion Problems Encountered in the Gas Turbine Industry." ... 193

Pedrotty, F. W. "Metal Cleaning and Finishing by the Airless Abrasive Blasting Process." 128

Philip, T. B. "The Use of Carbon Dioxide in the Engineering Industry." 25

Pitt, G. W. "Education for Management — Are We Falling Behind?" 734

Player, Denis. "Machine Tools of the Future" (with W. K. Temple). 628

"Productivity and the Second Industrial Revolution." 49

Puckey, Walter.

"The Challenge of the 'Dip.Tech.'." 699

	Page
"What is Meant by Practical Training?" ...	217
Puckle, O. S. "Numerical Control of Machine Tools in Aircraft Manufacture."	169
Pugh, D. S. "Some Human Aspects of Inspection" (with R. McKenzie).	378
Revans, R. W. "The Analysis of Industrial Behaviour."	448
Sargrove, John A. "Bread"—A Study in Progressive Development" (Case Study).	705
Scholes, H. "Production Engineering as a Training for Management."	274
Scott, Walter. "The Challenge of the Age." ...	293
Sheppard, A. W. "Contour Etching."	253
Smedley, John. "Compressed Air — A User's Experience" (with W. G. Wood).	749
Sommer, Gordon M. "Transfer Pressing" (with Robert H. Barlow).	646
Scheid, Erich Mittelsten. "The Challenge of the Age."	535
Sorenson, P. N. "High Production Tooling for Induction Heating" (with C. E. Glick).	40
Stuchbery, A. L. "Some Aspects of Automation."	755
Teed, P. L. "The Fatigue of Aircraft."	154
Temple, W. K. "Machine Tools of the Future" (with Denis Player).	628
Thompson, A. G. "Measuring and Forecasting Cost Data in Highly Variable Production."	771
Topping, J. "The Supply of Students for Technological Education"	1
Walter, W. Grey. "Thinking Machines."	4
Whittaker, B. "Apprentice Training in Small Firms."	396
Wilkes, T. H. "The Practice and Principles of Tube Manipulation."	32
Wilkinson, R. G. "The Hot Forming, Assembling and Service Applications of Magnesium Alloys." ...	224
Wood, W. G. "Compressed Air — A User's Experience" (with John Smedley).	749
Woodward, Joan. "Control and Communication — A Management Concept of Cybernetics." ...	539

NAMED PAPERS, SERIES AND PROCEEDINGS OF CONFERENCES

	Page
Automatic Production — Change and Control. Conference, Harrogate, 1957	
Asbridge, G. H. "The Application of Unit Heads and Special Machines as an Aid to Batch Production."	659
Barton, G. W. "Beer" (Case Study).	727
Brisch, E. G., and Geoghegan, R. S. "Simplification and Standardisation for Automation."	571
Eilon, S. "Scheduling for Batch Production." ...	549
England, E. C. Gordon. "Master and Man — A New Look at an Age-old Relationship."	583
Gibbs, C. B. "What New Skills Will the Future Demand?"	442
Gilbreth, Lillian M. "The Effect of Automation on Management Organisational Principles and Practices."	488
Halsbury, J. A. H. Giffard, Third Earl of. "The Administration of Modern Production." ...	480
Hancock, E. W. "What About the Small Firm?" ...	621
Hill, N. D. "Data Processing Systems as an Aid to Management."	510
Hunter, F. T. "The Cost of Automation."	416
James, C. G. "Boats" (Case Study).	719
Johnston, D. L. "Product Design for Automated Production."	494
Kease, W. J. "Computer-assisted Production Control."	423
Lebus, Anthony. "Beds" — And Their Making (Case Study).	715
Loxham, John. "The Control of Quality in Automatic Production."	676
Player, Denis, and Temple, W. K. "Machine Tools of the Future."	628
Puckey, Walter. "The Challenge of the 'Dip.Tech.'."	699
Revans, R. W. "The Analysis of Industrial Behaviour."	448
Sargrove, John A. "Bread"—A Study in Progressive Development.	705
Sommer, Gordon M., and Barlow, Robert H. "Transfer Pressing."	646
Woodward, Joan. "Control and Communication — A Management Concept of Cybernetics."	539
"The Challenge of the Age" (Leaders)	
Bedaux, Charles E.	355
Brunner, C. T.	73
Scheid, Erich Mittelsten	535
Scott, Walter	293
George Bray Memorial Lecture, 1956	
Beer, Stafford. "The Scope for Operational Research in Industry."	298
Lord Austin Prize Essay, 1956	
Onions, S. A. "Welding Distortion Problems Encountered in the Gas Turbine Industry." ...	193
Lord Sempill Paper, 1957	
Frydag, Karl. "Concentration of Aircraft Development." (Problems of Aircraft Production, Conference, No. 5, Southampton, 1957.) ...	146
Materials Handling Case Studies	
No. 10. Assembly of Plastics Door Furniture. ...	52
No. 11. Handling of Refractories.	286
Midlands Region Conference, 1956	
Graves, H. J. "An Outline of B.M.C. Development in the Field of Automation."	18
Griffiths, F. "An Outline of Processes, Assemblies and Material Movement."	23
Holbeche, H. W. "Design and Manufacturing Problems."	20
Problems of Aircraft Production, Conference, No. 5, Southampton, 1957	
Frydag, Karl. "Concentration of Aircraft Development." (Lord Sempill Paper.)	146
Gardner, N. K. "Recent Advances in the Application of Resistance Welding to Airframe Construction."	238
Puckle, O. S. "Numerical Control of Machine Tools in Aircraft Manufacture."	169
Sheppard, A. W. "Contour Etching."	253
Teed, P. L. "The Fatigue of Aircraft."	154
Wilkinson, R. G. "The Hot Forming, Assembling and Service Applications of Magnesium Alloys." ...	224
Schofield Scholarship Paper, 1956	
Scholes, H. "Production Engineering as a Training for Management."	274
Sir Alfred Herbert Paper, 1956	
Bowden, B. V. "The Development of Technological Education in Europe, America and England." ...	75
Viscount Nuffield Paper, 1956	
Walter, W. Grey. "Thinking Machines."	4

Page

Aircraft Fatigue
Teed, P. L. "The Fatigue of Aircraft." (Problems of Aircraft Production. Conference, No. 5, Southampton, 1957.) 154

Aircraft Manufacture
see also: Aircraft Materials; Contour Etching — Aircraft; Machine Tool Control, Numerical — Aircraft Manufacture; Welding, Resistance — Aircraft.
Frydag, Karl. "Concentration of Aircraft Development." (Problems of Aircraft Production. Conference, No. 5, Southampton, 1957.) ... 146

Aircraft Materials — *Magnesium*
Wilkinson, R. G. "The Hot Forming, Assembling and Service Applications of Magnesium Alloys." (Problems of Aircraft Production. Conference, No. 5, Southampton, 1957.) 224

Apprentice Training
see also: Employee Training.
Whittaker, B. "Apprentice Training in Small Firms." 396

Australia
see: Technical Change and Industry — *Australia*.

Automatic Control
see: Machine Tool Control, Numerical.

Automatic Manufacture
— Product Design
Johnston, D. L. "Product Design for Automated Production." (Automatic Production—Change and Control. Conference, Harrogate, 1957.) 494
— Quality Control
Loxham, John. "The Control of Quality in Automatic Production." (Automatic Production—Change and Control. Conference, Harrogate, 1957.) 676

Automation
see also: Automatic Manufacture; Machine Tool Control, Numerical.
Halsbury, J. A. H. Giffard, Third Earl of. "Automation — Verbal Fiction, Psychological Reality." 333
Stuchbery, A. L. "Some Aspects of Automation." 755
— Economic Aspects
Hunter, F. T. "The Cost of Automation." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 416

Automobile Manufacture
see: British Motor Corporation — *Manufacturing Methods*.

Bakeries
Sargrove, John A. "Bread"—A Study in Progressive Development" (Case Study). (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 705

Batch Production
Asbridge, G. H. "The Application of Unit Heads and Special Machines as an Aid to Batch Production." (Automatic Production—Change and Control. Conference, Harrogate, 1957.) 659
Eilon, S. "Scheduling for Batch Production." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 549

Bed Manufacture
Lebus, Anthony. "Beds"—And Their Making (Case Study. (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 715

Page

Blast Cleaning
Pedrotty, F. W. "Metal Cleaning and Finishing by the Airless Abrasive Blasting Process." 128

Boat Building
James, C. G. "Boats" (Case Study). (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 719

Bread Making
see: Bakeries.

Breweries
Barton, G. W. "Beer" (Case Study). (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 727

British Motor Corporation — *Manufacturing Methods*
Graves, H. J. "An Outline of B.M.C. Development in the Field of Automation." (Midlands Region Conference, 1956.) 18
Griffiths, F. "An Outline of Processes, Assemblies and Material Movement." (Midlands Region Conference, 1956.) 23
Holbeche, H. W. "Design and Manufacturing Problems." (Midlands Region Conference, 1956.) 20

Carbon Dioxide Coolants
Philip, T. B. "The Use of Carbon Dioxide in the Engineering Industry." 25

Chemical Milling
see: Contour Etching.

Classification Schemes
see: Stores and Materials Classification.

Cleaning, Blast
see: Blast Cleaning.

Compressed Air
Smedley, John, and W. G. Wood. "Compressed Air — A User's Experience." 749

Computer-assisted Production Control
see: Production Planning and Control, Computer-assisted.

Contour Etching — *Aircraft*
Sheppard, A. W. "Contour Etching." (Problems of Aircraft Production. Conference, No. 5, Southampton, 1957.) 253

Control
see: Machine Tool Control, Numerical.

Coolants, Carbon Dioxide
see: Carbon Dioxide Coolants.

Costing
see also: Marginal Costing.
Thompson, A. G. "Measuring and Forecasting Cost Data in Highly Variable Production." 771

Cybernetics
Beer, Stafford. "The Scope for Operational Research in Industry." Part III—Cybernetics. (George Bray Memorial Lecture, 1956.) 317
Walter, W. Grey. "Thinking Machines." (Viscount Nuffield Paper, 1956.) 4
Woodward, Joan. "Control and Communication — A Management Concept of Cybernetics." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 539

Page

Data Processing
Hill, N. D. "Data Processing Systems as an Aid to Management." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) ... 510

Design
see: Automatic Manufacture — *Product Design*.

Education, Technical
see also: Apprentice Training; Employee Training; Management — *Training*; Skill — *Transfer and Utilisation*.
Bowden, B. V. "The Development of Technological Education in Europe, America and England." (Sir Alfred Herbert Paper, 1956.) 75
Fedden, Roy. "The National Need for Technologists — Can We Meet the Demand?" 360
Puckey, Walter.
"What is Meant by Practical Training?" ... 217
"The Challenge of the 'Dip.Tech.'." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 699
Topping, J. "The Supply of Students for Technological Education." 1

Employee-Employer Relationship
England, E. C. Gordon. "Master and Man—A New Look at an Age-old Relationship." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 583

Employee Training
Gibbs, C. B. "What New Skills Will the Future Demand?" (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 442

Enamelling
see: Stove Enamelling.

Factories Acts
Barnett, George. "The Factories Acts — How They Affect Engineering Establishments." 279

Fatigue of Aircraft
see: Aircraft Fatigue.

Finishing
see: Stove Enamelling.

Furniture Manufacture
see: Bed Manufacture.

Gas Turbine Manufacture
see: Welding — *Gas Turbines*.

Gauging, Pneumatic
Evans, J. C. "The Pneumatic Gauging Technique in its Application to Dimensional Measurement." ... 110

Germany
see: Technical Change and Industry — *Germany*.

Heating, Induction
Glick, C. E., and Sorenson, P. N. "High Production Tooling for Induction Heating." 40

Hot Working — *Magnesium*
Wilkinson, R. G. "The Hot-Forming, Assembling and Service Applications of Magnesium Alloys." (Problems of Aircraft Production. Conference No. 5. Southampton, 1957.) 224

Industrial Law
see: Factories Acts.

Industrial Psychology
Revans, R. W. "The Analysis of Industrial Behaviour." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 448

Page

Industrial Relations
see: Employee-Employer Relationship.

Industrial Sociology
see also: Personnel Management; Skill — *Transfer and Utilisation*.
England, E. C. Gordon. "Master and Man — A New Look at an Age-old Relationship." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 583
Hancock, E. W. "People in Industry — the Changing Pattern of Industrial Society." 365

Industry — *Structure and Organisation*
see: Small Firms.

Industry and Technical Change
see: Technical Change and Industry.

Inspection
see also: Testing, Non-Destructive.
McKenzie, R., and Fugh, D. S. "Some Human Aspects of Inspection." 378

Job Evaluation
Jaques, Elliott. "The Impact of the Production Engineer Upon the Structure of Work and Payment in Industry." 344

Law
see: Factories Acts.

Machine Tool Control, Numerical — *Aircraft Manufacture*
Puckle, O. S. "Numerical Control of Machine Tools in Aircraft Manufacture." (Problems of Aircraft Production. Conference, Southampton, 1957.) ... 169

Machine Tools
see also: Machine Tool Control, Numerical; Multi-Spindle Automatics; Unit Heads for Machine Tools.
Player, Denis, and Temple, W. K. "Machine Tools of the Future." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) ... 628

Magnesium
see: Aircraft Materials — *Magnesium*; Hot Working *Magnesium*.

Management — *Training*
Pitt, G. W. "Education for Management — Are We Falling Behind?" 734
Scholes, H. "Production Engineering as a Training for Management." (Schofield Scholarship Paper, 1956.) 274

Management and Technical Change
see: Technical Change and Management.

Manpower
see: Technical and Scientific Manpower.

Marginal Costing
Harrison, W. E. "Practical Marginal Costing." ... 121

Marketing
Brunner, C. T. "The Challenge of the Age." ... 73

Materials Classification
see: Stores and Materials Classification.

Materials Handling
Materials Handling Sub-Committee.
Case Study No. 10 — Assembly of Plastics Door Furniture 52
Case Study No. 11 — Handling of Refractories 286

Mathematics, Industrial
see: Operational Research.

Page

Metrology
see: Gauging, Pneumatic.

Multi-Spindle Automatics — *Applications*
Jackson, R. "High Speed Production from Bar Material." 515

Non-Destructive Testing
see: Testing, Non-Destructive.

Numerical Control
see: Machine Tool Control, Numerical.

Operational Research
Beer, Stafford. "The Scope for Operational Research in Industry." (George Bray Memorial Lecture. 1956.) 298
Halsbury, J. A. H. Giffard, Third Earl of. "The Administration of Modern Production." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 480

Personnel Management
see also: Employee-Employer Relationship; Job Evaluation.
Burstall, A. F. "Working Together With Other Men." 663

Pneumatic Gauging
see: Gauging, Pneumatic.

Presses, Transfer
see: Transfer Pressing.

Presswork
see also: Transfer Pressing.
Galway, J. "Tooling for Precision Presswork." ... 760

Product Design
see: Automatic Manufacture — *Product Design*

Production Planning and Control
Eilon, S. "Scheduling for Batch Production." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 549

Production Planning and Control, Computer-assisted
Kease, W. J. "Computer-assisted Production Control." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 423

Psychology, Industrial
see: Industrial Psychology.

Quality Control
see: Automatic Production — *Quality Control.*

Resistance Welding
see: Welding, Resistance.

Scheduling for Production
see: Production Planning and Control.

Scientific Manpower
see: Technical and Scientific Manpower.

Sheet Metal Working
see also: Contour Etching.
Grainger, John A. "New Techniques in Sheet Metal Forming." 593

Skill — *Transfer and Utilisation*
Gibbs, C. B. "What New Skills Will the Future Demand?" (Automatic Production — Change and Control. Conference, Harrogate, 1957.) ... 442

Small Firms
Hancock, E. W. "What About the Small Firm?" (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 621

Page

Sociology, Industrial
see: Industrial Sociology.

South Africa
see: Technical Change and Industry—*South Africa*.

Stores and Materials Classification
Brisch, E. G., and Geoghegan, R. S. "Simplification and Standardisation for Automation." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 571

Stove Enamelling
Liptrot, D. "The Recirculating Hot Air Oven Applied to Stove Enamelling." 389

Technical and Scientific Manpower
Fedden, Roy. "The National Need for Technologists — Can We Meet the Demand?" 360
Ministry of Labour and National Service. "The Technical and Scientific Register." 462

Technical Change and Industry
"Productivity and the Second Industrial Revolution." Report of a discussion group . . . at the Alpach European Forum, 1956. 49
—*Australia*
Scott, Walter. "The Challenge of the Age." ... 293
—*Germany*
Scheid, Erich Mittelsten. "The Challenge of the Age." 535
—*South Africa*
Bedaux, Charles E. "The Challenge of the Age." ... 355

Technical Change and Management
Gilbreth, Lillian M. "The Effect of Automation on Management Organisational Principles and Practices." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 488

Technical Change and New Skill
see: Skill — *Transfer and Utilisation.*

Technical Education
see: Apprentice Training; Education, Technical; Employee Training; Skill — *Transfer and Utilisation.*

Testing, Non-Destructive
Cook, W. G. "Non-Destructive Testing and the Production Engineer." 97

Transfer Pressing
Sommer, Gordon M., and Barlow, Robert H. "Transfer Pressing." (Automatic Production — Change and Control. Conference, Harrogate, 1957.) 646

Tube Manufacture
Wilkes, T. H. "The Practice and Principles of Tube Manipulation." 32

Unit Heads for Machine Tools
Asbridge, G. H. "The Application of Unit Heads and Special Machines as an Aid to Batch Production." (Automatic Production—Change and Control. Conference, Harrogate, 1957.) 659

Welding — *Gas Turbines*
Onions, S. A. "Welding Distortion Problems Encountered in the Gas Turbine Industry." (Lord Austin Prize Essay, 1956.) 193

Welding, Resistance — *Aircraft*
Gardner, N. K. "Recent Advances in the Application of Resistance Welding to Airframe Construction." (Problems of Aircraft Production. Conference, No. 5, Southampton, 1957.) 238

The Council of the Institution

1957/58

President

The Rt. Hon. The Earl of Halsbury, F.R.I.C., F.Inst.P

Vice-Presidents

J. E. Hill G. R. Pryor

Chairman of Council

H. G. Gregory

Vice-Chairman of Council

H. W. Bowen, O.B.E.

Past Presidents

Major-General K. C. Appleyard, C.B.E. Sir George Bailey, C.B.E. E. W. Hancock, M.B.E. Sir Leonard Lord, K.B.E. The Rt. Hon. Viscount Nuffield, G.B.E. Sir Walter Puckey. Norman Rowbotham, C.B.E. J. D. Scaife, Dr. H. Schofield, C.B.E. The Rt. Hon. Lord Sempill, A.F.C. Sir Cecil Weir, K.C.M.G., K.B.E., D.L., M.C.

Presidents of Councils outside the United Kingdom

AUSTRALIAN COUNCIL—W. Gwinnett
SOUTH AFRICAN COUNCIL—D. E. Hamm

Chairmen of Regional Committees

East & West Ridings
G. R. Pryor

Eastern
F. T. Dyer

Midlands
B. G. L. Jackman

North Midlands
L. Shenton

Northern
C. B. Abbey

North Western
J. H. Winskill

Northern Ireland
K. Teale

Scotland
A. Betts Brown

South Eastern
R. Telford

Southern
D. L. Wiggins

South Western
R. W. Hancock

Wales
W. H. Bowman

Additional Representatives on Council

East & West Ridings
H. Crompton

Midlands
E. Percy Edwards

North Western
F. W. Cranmer

South Eastern
J. L. Gwyther

Chairmen of Standing Committees

J. M. Brice (*Editorial*) F. G. S. English (*Research*) A. A. J. Francis (*Papers*) H. L. Madeley (*Library*) J. France (*Education*) H. Stafford (*Standards*) K. J. Hume (*Membership*)

Elected Members

G. V. Bevan H. W. Bowen, O.B.E. H. Burke R. S. Clark L. R. Evans F. J. Everest E. F. Gilberthorpe A. Griffiths, O.B.E. F. Grimshaw, O.B.E. S. J. Harley H. B. Harris H. W. Hodson R. E. Leakey F. T. Nurrish, M.B.E. L. S. Pitteway A. L. Stuchbery C. Timms R. H. S. Turner

Chairmen of Sections outside the United Kingdom where Councils are not established

Bombay
C. H. De Sousa

Canada
C. E Barkworth

Calcutta
P. Bhattacharji

New Zealand
H. K. Pickering

Overseas Councils

AUSTRALIA

President
W. Gwinnett

Chairman
F. W. Penny

Immediate Past President
J. N. Kirby, O.B.E.

Vice-Chairman
J. M. Steer

Hon. Secretary
L. W. Worthington

Hon. Treasurer
K. Slorach

Delegates
H. J. Baker C. J. Clark J. W. H. Clarke C. S. Curtis R. W. Deutsher S. Downie N. L. Eaton N. A. Esserman A. H. Evans P. E. Frye W. L. Hemer E. J. W. Herbert J. O. Ogden C. Pullen H. G. Sutton

SOUTH AFRICA

President
D. E. Hamm

Vice-President
T. H. Hunter

Past Presidents
A. B. Anderson R. H. Arbuckle L. H. L. Badham D. N. S. Clare W. G. Gillespie H. J. G. Govns J. Henry D. Lion-Cachet J. Renwick A. C. Wotherspoon

Elected Members
G. T. Chawner E. H. Dallas P. C. Ellett G. K. Melvill C. J. Mogford D. A. Petrie G. G. Tardrew H. H. Waters T. F. B. de Villiers F. Westall

REGIONAL HONORARY SECRETARIES

East & West Ridings ...	T. F. Newton	**Northern Ireland**	J. G. Easterbrook
Eastern	A. B. Brook	**Scotland**	W. H. Marley
Midlands	A. C. Turner	**South Eastern**	J. Aikman
North Midlands	C. N. T. Manfull	**Southern**	J. W. Taylor
Northern	W. W. Sweet	**South Western**	A. Eustace
North Western	J. P. Speakman	**Wales**	C. L. Clarke

SECTION CHAIRMEN

F. W. Penny	*Adelaide*	J. M. Steer	*Melbourne*
R. N. Marland	*Birmingham*	H. K. Pickering	*New Zealand*
C. H. De Sousa	*Bombay*	C. B. Abbey	*Newcastle upon Tyne*
P. Bhattacharji	*Calcutta*	K. Teale	*Northern Ireland*
C. E. Barkworth	*Canada*	R. E. Copelin	*Norwich*
W. Abraham	*Cardiff*	T. G. H. Middleton	*Nottingham*
F. G. Robinson	*Cornwall*	L. P. Coombes	*Oxford*
V. W. Oubridge	*Coventry*	W. Peck	*Peterborough*
A. G. Clark	*Derby*	W. L. Jones (Acting)	*Preston*
G. R. Whitehead	*Doncaster*	H. A. Richardson	*Reading*
R. B. Thomson	*Dundee*	W. Robinson	*Rochester*
P. H. Lee	*Edinburgh*	J. R. Widdowson	*Sheffield*
J. Menzies	*Glasgow*	W. Castledine	*Shrewsbury*
A. J. Lissaman	*Gloucester*	D. E. Hamm	*South Africa*
W. A. Hannaby	*Halifax & Huddersfield*	P. H. W. Everitt	*South Essex*
L. A. Childs	*Ipswich & Colchester*	Capt. V. J. Sankey	*Swansea*
H. Crompton	*Leeds*	D. L. Wiggins	*Southampton*
L. S. Pitteway	*Leicester*	H. A. Armstrong	*Stoke-on-Trent*
G. C. Oram	*Lincoln*	S. Downie	*Sydney*
H. Mason	*Liverpool*	J. W. Woodger	*Tees-Side*
G. R. Blakely	*London*	R. W. Hancock	*Western*
J. L. Gwyther	*Luton*	G. A. Firkins	*Wolverhampton*
F. W. Cranmer	*Manchester*	H. C. Branfield	*Worcester*

GRADUATE SECTION CHAIRMAN

T. B. Wilcox	*Birmingham Graduate*	L. E. Chadderton	*Manchester Graduate*
T. E. G. Fulker	*Coventry Graduate*	P. J. Cottrell	*Melbourne Graduate*
H. Scholes	*Halifax & Huddersfield Graduate*	H. E. A. Noble	*Newcastle upon Tyne Graduate*
R. C. Taylor	*Leeds Graduate*	B. E. Thornby	*Rochester Graduate*
L. E. Crisp	*Liverpool Graduate*	J. Rook	*Sheffield Graduate*
D. J. Jerrard	*London Graduate*	J. E. Heape	*Western Graduate*
M. J. Hemmett	*Luton Graduate*	B. McCloskey	*Wolverhampton Graduate*

SECTION HONORARY SECRETARIES

AUSTRALIA

Adelaide (South Australia) ...	W. L. Hemer, 6 Bedford Street, Brooklyn Park, South Australia.
Melbourne (Victoria, Australia)	R. W. Deutsher, 374 Nepean Highway, Brighton, Victoria, Australia.
Melbourne Graduate (Victoria Australia)	F. A. Roberts, 20 Kent Avenue, Elwood, S.3, Victoria, Australia.
Sydney (New South Wales) ...	K. G. Slorach, 34 Anderson Avenue, Ryde, New South Wales, Australia.

CANADA

Canada	Frank S. Taylor, 1 Cheritan Avenue, Apt. 110, Toronto 12, Ontario, Canada.

INDIA

Bombay	C. R. Pal, The Crescent Iron & Steel Works Ltd., Goregaon (East), Bombay, S.D., India.
Calcutta	S. R. Chatterjee, Machinery Manufacturing Corporation Ltd., P.61 Circular Garden Reach Road, Kidderpore, Calcutta, India.

NEW ZEALAND

New Zealand	G. Stedman, 3 Harrison Avenue, Belmont, Takapuna, Auckland, New Zealand.

SOUTH AFRICA

South Africa	A. Aitken, 209/211 Pharmacy House, 80 Jorissen Street, Johannesburg, P.O. Box 10837, South Africa.

UNITED KINGDOM

Birmingham	H. W. White, "Spring Pools", 67 Birmingham Road, Lydiate Ash, Bromsgrove, Worcs.
Cardiff	C. L. Griffiths, "Brynteg", 139 Tyntyla Road, Llwynypia, Rhondda, Glamorgan.
Cornwall	F. G. Hawke, 17 Church Road, Pool, Redruth, Cornwall.
Coventry	A. S. Hopkins, 39 Oaks Road, Kenilworth, Warwicks.
Derby	P. Warburton, 16 Vicarage Road, Chellaston, Derby.
Doncaster	G. R. Wimpenny, 16 Tickhill Square, Denaby Main, Doncaster.
Dundee	J. Nicolson Low, Technical College, Bell Street, Dundee.
Edinburgh	A. S. Wilson, 46 Hawthorn Vale, Edinburgh, 6.
Glasgow	W. H. Marley, G. & J. Weir Ltd., Cathcart, Glasgow, S.4.
Gloucester	B. E. Gwynne Clarke, "Chez-Nous", Okus Road, Charlton Kings, Cheltenham.
Halifax & Huddersfield ...	C. W. Overin, 353 Whitehall Road, Westfield, Wyke, near Bradford, Yorks.
Ipswich & Colchester ...	H. F. Harker, Ransomes, Sims & Jefferies Ltd., Orwell Works, Ipswich.
Leeds	J. L. Townend, 26 Moor Allerton Drive, Street Lane, Leeds, 17.
Leicester & District	E. G. Davis, 19 Festival Avenue, Humberston Lane, Thurmaston, Leics.
Lincoln	H. Wright, 101 Longdales Road, Lincoln.
Liverpool	J. Irwin, 75 Manor Drive, Upton, Wirral, Cheshire.
London	R. J. C. Whitaker, The Glacier Metal Co. Ltd., Ealing Road, Alperton, Middx.
Luton	J. F. W. Galyer, Engineering Department, Luton & South Bedfordshire College of Further Education, Park Square, Luton, Beds.
Manchester	J. P. Speakman, 223 Douglas Road, Atherton, near Manchester.
Newcastle upon Tyne ...	A. C. Foskew, 35 Oakwood Avenue, Low Fell, Gateshead, 9.
Northern Ireland	J. G. Easterbrook, "Hilleen", 22 Ascot Park, Knock, Belfast.
Norwich	J. I. Hilder, 2a Gorse Road, Thorpe, Norwich.
Nottingham	C. N. T. Manfull, Chellaston House, Thurgarton Street, Nottingham.
Oxford	F. S. Chappell, 58 Lancut Road, Witney, Oxfordshire.
Peterborough	N. Holmes, "Arncliffe", 11 Mary Armyn Road, Orton Longueville, Peterborough.
Preston	W. H. Preston, 25 Clifton Avenue, Leyland, Lancashire.
Reading	R. W. H. Mark, "The Beeches", 41 Reading Road, Woodley, Berkshire.
Rochester & District ...	W. G. Clements, 11 Charing Road, Gillingham. Kent.
Sheffield	T. F. Newton, c/o E. Pryor & Son Ltd., West End Works, Broom Street, Sheffield, 10.
Shrewsbury	W. M. Buchan, Llanberis, 36 Mytton Oak Road, Shrewsbury.
Southampton	J. W. Taylor, 44 Deacon Road, Bitterne, Southampton.
South Essex	F. Hopkinson, "Woodley", 40 Highfield Road, Chelmsford, Essex.
Swansea	C. L. Clarke, 11 Alder Road, Cimla, Neath, South Wales.
Stoke-on-Trent	W. R. Bailey, "Rivelyn", Crossfield Avenue, Knypersley, Biddulph, Stoke-on-Trent.
Tees-Side	J. H. Cooper, 48 Hob Hill Close, Saltburn-by-the-Sea, Yorks.
Western	A. Eustace, 19 Ferndale Road, Northville, Bristol, 7.
Wolverhampton	R. J. Sury, Widdicombe House, 2 Buttons Farm Road, Penn, Wolverhampton.
Worcester	R. Wheeler, Old House Farm, Parish Hill, Bournheath, near Bromsgrove, Worcs.

CORRESPONDING MEMBER IN MIDDLE EAST

J. Merkine, 45 Arlozoroff Street, Ramat-Gan, Israel.

CORRESPONDING MEMBER IN IRAQ

W. G. Rooke, Production Engineer, Iraqi State Railways, Shalchiyah, Baghdad, Iraq.

CORRESPONDING MEMBER IN WEST AFRICA

H. P. Halfter, Gold Coast Railways & Harbour Admin., P.O. Box 202, Takoradi, Ghana, West Africa.

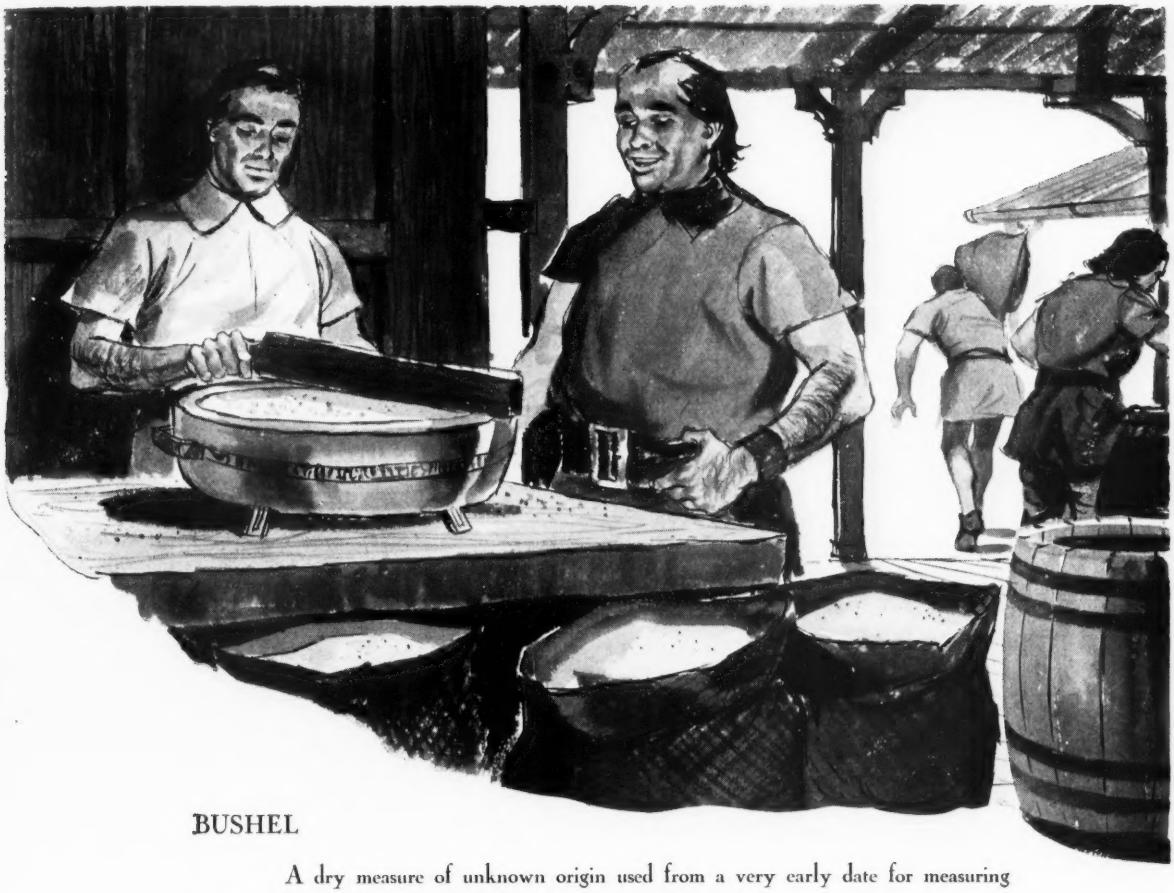
GRADUATE SECTION HONORARY SECRETARIES

Birmingham	R. V. Whateley, c/o 130 Church Road, Moseley, Birmingham, 13.
Coventry	B. Brewster, 86 Nunts Park Avenue, Nunts Park, Coventry.
Halifax & Huddersfield ...	G. Wilde, 56 Milton Avenue, Albert Road, Sowerby Bridge, near Halifax.
Leeds	J. Keightley, Flat 3, 8 The Avenue, Roundhay, Leeds, 8.
Liverpool	C. Armstrong, 73 Faversham Road, Norris Green, Liverpool, 11.
London	R. J. Temple, 39 Court Close, Twickenham, Middlesex.
Luton	C. Halton, 18 Churchill Road, St. Albans, Hertfordshire.
Manchester	R. C. Yarnell, 25 Alderley Close, Hazel Grove, Cheshire.
Newcastle upon Tyne ...	R. Scott, 71 Monk Street, Gateshead, 8, Co. Durham.
Rochester & District ...	J. R. Anderson, 63 Watling Street, Strood, Rochester, Kent.
Sheffield	E. Willcox, Ellis, Son, & Paramore Ltd., Spring Street Works, Sheffield, 3.
Western	T. G. Mossman, 5 Arlington Mansions, Arlington Villas, Clifton, Bristol, 8.
Wolverhampton	T. J. Harrison, "The Dingle", Planks Lane, Wombourne, Staffs.

LOUGHBOROUGH COLLEGE STUDENT SECTION

Chairman: T. N. Bennett, 25 Ambergate Drive, Birstall, Leicester.

Honorary Secretary: R. A. Mortimore, College of Technology, Loughborough.



BUSHEL

A dry measure of unknown origin used from a very early date for measuring grain. One of the early vessels used was of bronze, the grain being poured in until flowing over, then scraped level with a striker. In 1497 the "Winchester" bushel was standardised by statute as 800 Troy ounces of wheat by "striked" measure. The imperial bushel established in 1826 has a capacity of 80 lbs of pure water.

Over the years, standards have been evolved by man to meet his personal needs and to regulate his trade and general relationships with his fellows.

The main function of the British Standards Institution is to set up and maintain standards of quality, fitness for purpose and performance so that users may rest assured that they are obtaining value for money.

In some cases the existing procedure of a producer is accepted as the best practice of the art and is taken as a basis for the standard in question. Thus British Standard 1004 (Zinc Alloys for Die Casting) was based on the established practice of the Imperial Smelting Corporation in the production of MAZAK.

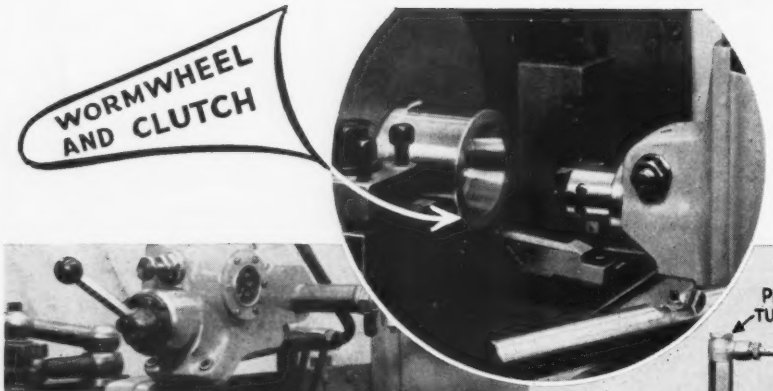
MAZAK

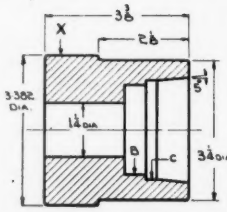
The Standard by which others are judged.

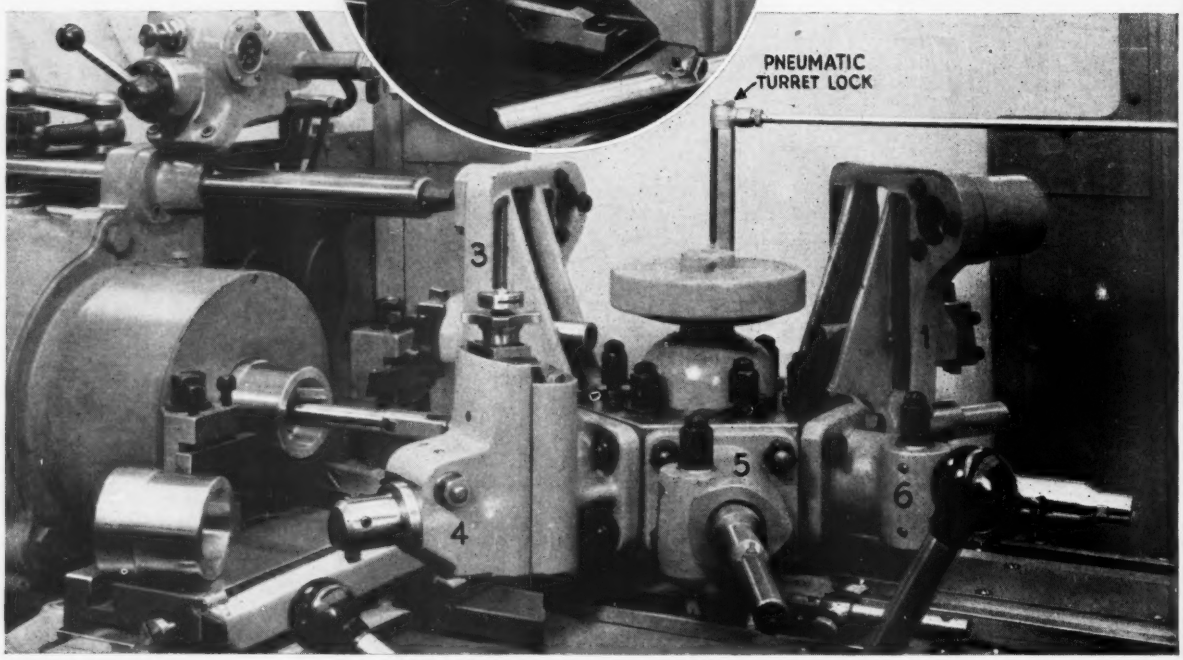
A PRODUCT OF IMPERIAL SMELTING

CONSOLIDATED ZINC CORPORATION (SALES) LIMITED, 37 DOVER STREET, LONDON, W.I.

Maximum Production Special Tool Layouts







Ward No. 3A CAPSTAN LATHE

FITTED WITH 7½in 3-JAW AIR CHUCK

Tungsten Carbide Cutting Tools

PHOSPHOR BRONZE CASTING

Floor-to-Floor Time: 3 mins. 10 secs. each.

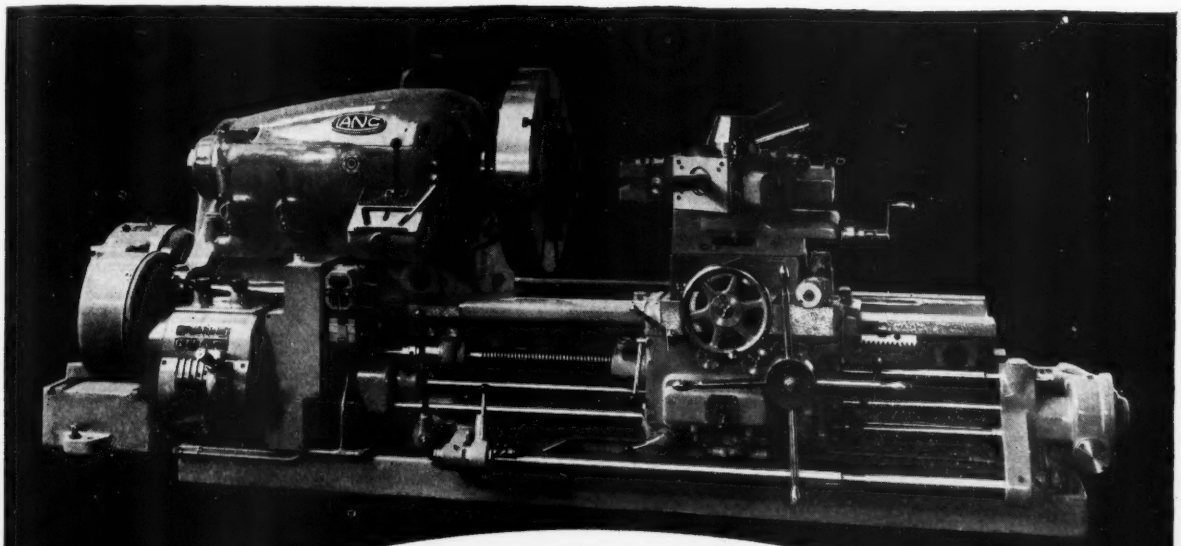
DESCRIPTION OF OPERATION	Tool Position		Spindle Speed R.P.M.	Surface Speed Ft. per Min.	Feed Cuts per inch
	Hex. Turret	Cross-slide			
1. Chuck on X	—	—	—	—	—
2. Rough Face End	—	Rear	540	480	Hand
3. Rough Bore 1¼" and Knee Turn 3¼"	1	—	540	480	125
4. Finish Bore B and C	2	—	955	624	125
5. 2nd Bore 1¼" dia. Finish Knee Turn 3¼"	3	—	955	812	125
6. Face End and Radius	—	Front	1650	1404	Hand
7. Taper Bore (2 Cuts)	4	—	1650	1080	234
8. Microbore 1¼" dia.	5	—	1650	540	234
9. Chamfer Corners	6	—	1650	1080	Hand
10. Remove	—	—			

H·W·WARD & CO LTD

SELLY OAK
BIRMINGHAM 29
TELEPHONE SELLY OAK 1131

ASSOC. BRITISH MACHINE TOOL MAKERS LTD

W652



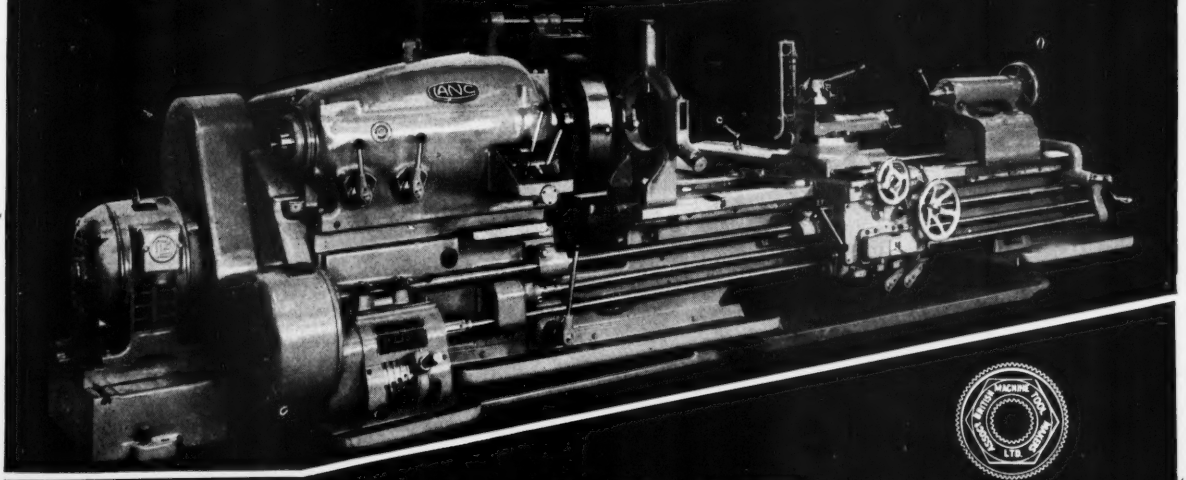
LANG

model CA4

SURFACING BORING & SCREWCUTTING LATHES. 36″ & 48″ SWING.

SLIDING SURFACING & SCREWCUTTING LATHES. 24″ TO 36″ SWING.

model A4



JOHN LANG & SONS LTD.

JOHNSTONE — RENFREWSHIRE

Telephone: Johnstone 400

Telegrams: "Lang Johnstone"

LONDON OFFICE:
ASSOCIATED BRITISH
MACHINE TOOL MAKERS LTD.
17, GROSVENOR GARDENS, SW1

Churchill

OSB

HORIZONTAL SPINDLE SURFACE GRINDING MACHINE

This machine is designed for work requiring extremely accurate and highly finished flat surfaces. Besides being ideal for tool room work and for die grinding, the Model 'OSB' can be used to advantage in the production line. High rates of output are obtainable. Built in three sizes with work tables 30" × 10", 42" × 10" and 60" × 10".

Easy and simple operation.

Built-in motor drive to grinding wheel spindle. Motorised automatic pump lubricating system and simple bearing assembly give a high precision spindle capable of heavy grinding cuts.

Variable hydraulic cross feed to wheel. Pre-set automatic cut-out and automatic reverse.

Fine and coarse vertical feed.

Massive cross slide underneath wheelhead column gives large area of support and maximum stability.

Hydraulic table traverse up to 90 feet per minute. Hand traverse interlocked with hydraulic control.

Permanently protected precision ground table slideways.

Table traverse ways, wheelhead cross slideways and cross feed gears and bearings automatically lubricated from oil supply independent of hydraulic system.

BRITISH MACHINE TOOL MAKERS ASSOCIATION LTD.

THE CHURCHILL MACHINE TOOL CO. LTD., BROADHEATH, nr. MANCHESTER.
Telephone: Altrincham 3262. Telegrams: Churchale, Manchester.

Export Sales Organisation: Associated British Machine Tool Makers Ltd., London, Branches and Agents.

Home Selling Agents: Charles Churchill & Co. Ltd., Birmingham and Branches.

PRECISION *plus* PRODUCTION

C662-1D

Testing a 40" Hypoid Gear and Pinion for a Pulper. photo by courtesy of Black Clawson International Ltd.

Spiral Bevel and Hypoid Gears from 1" to 72"

Spiral Bevel and Hypoid Gears offer many advantages for right angle drives where high efficiency smooth and silent running are required. E.N.V. specialize in the design and manufacture of straight and curved tooth bevel gears. They offer collaboration with engineers from the project stage on the design of gears and mountings. They have unique facilities for the large-scale manufacture of transmissions including final drives, differentials and axles for vehicles and agricultural equipment, precision gears for aircraft and gears for industrial applications.

ENV for gears

E.N.V. ENGINEERING COMPANY LIMITED
Telephone : *HYTHE ROAD, WILLESDEN, LONDON, N.W.10*
LADbroke 3622

AP 265-56

NLD Radial Drilling Machine

a light-duty machine for fast, accurate production

This is the ideal radial for many drilling and tapping jobs where comparatively light duty is required, often with a large radial swing.

The Asquith NLD is available with maximum radius spindle centre to pillar centre from 3 ft. 6 ins. up to 8 ft.

Write today for full details.

WILLIAM ASQUITH LTD.

HALIFAX . ENGLAND

Sales & Service for . . . **DRUMMOND-ASQUITH** *. . . the British Isles*

DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW ST., BIRMINGHAM

'Phone : Midland 3431 (7 lines) 'Grams : Maxishape, B'ham. Also at LONDON : Phone : Trafalgar 7224 (5 lines) and GLASGOW : 'Phone : Central 3411

A153

MAXIRAPID

AUTOMATIC MULTI-TOOL LATHE

designed specifically for fully automatic high output production

Top illustration shows loading arm ready for automatic exchange of components between centres.

Lower illustration shows slides in cutting position. Unmachined components can be seen at the front of the loading unit. Machined parts are ejected at the rear of unit.

DRUMMOND BROS. LTD.

GUILDFORD · ENGLAND

The illustrations above show the "Maxirapid" tooled up for turning forged steel final-drive pinions. This example demonstrates the possibilities of the machine for really high speed heavy duty production.

Full advantage is taken of the adequate power and rigidity of the "Maxirapid", carbide tools being employed for all turning operations, and automatic loading and unloading is provided. Maximum swing over bed of the "Maxirapid" is 17 ins. and maximum distance between centres 24 ins. A 25, 35 or 50 h.p. motor can be fitted. The illustrations show the machine with splash guards removed.

Write today for a catalogue and get full details.

Sales & Service for . . . **DRUMMOND-ASQUITH** *. . . the British Isles*

DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW ST., BIRMINGHAM

'Phone : Midland 3431 (7 lines) 'Grams : Maxishape, B'ham. Also at LONDON : Phone : Trafalgar 7224 (5 lines) and GLASGOW : 'Phone : Central 3411

A.113

7 DAYS FREE LOAN

INVESTIGATE THE ECONOMICS AT OUR EXPENSE!

(ONLY APPLICABLE IN GREAT BRITAIN)

Convinced that many manufacturers do not realise the full potential of multi-drilling, we invite you to take advantage of the following offer :-

So that the speed and economy of multi-drilling may be fully appreciated, the AE2 Adjustable Centre Drill Head (as illustrated) will be loaned **free for 7 days.** This equipment will fit any drilling machine with a number 2 MT. spindle and will drill two holes up to 9/32" diameter at any centre distance between $\frac{3}{8}$" and $4\frac{3}{8}$".

To take advantage of this offer—fill in coupon below

We wish to borrow an AE2 drillhead for 7 days free trial. We will return the unit in good condition after 7 days or remit by the 20th of the month following ... £42-6-0

No. 4

FIRM .....

.....

.....

Signature..... Status .....

SIZE OF HOLE TO BE DRILLED .....

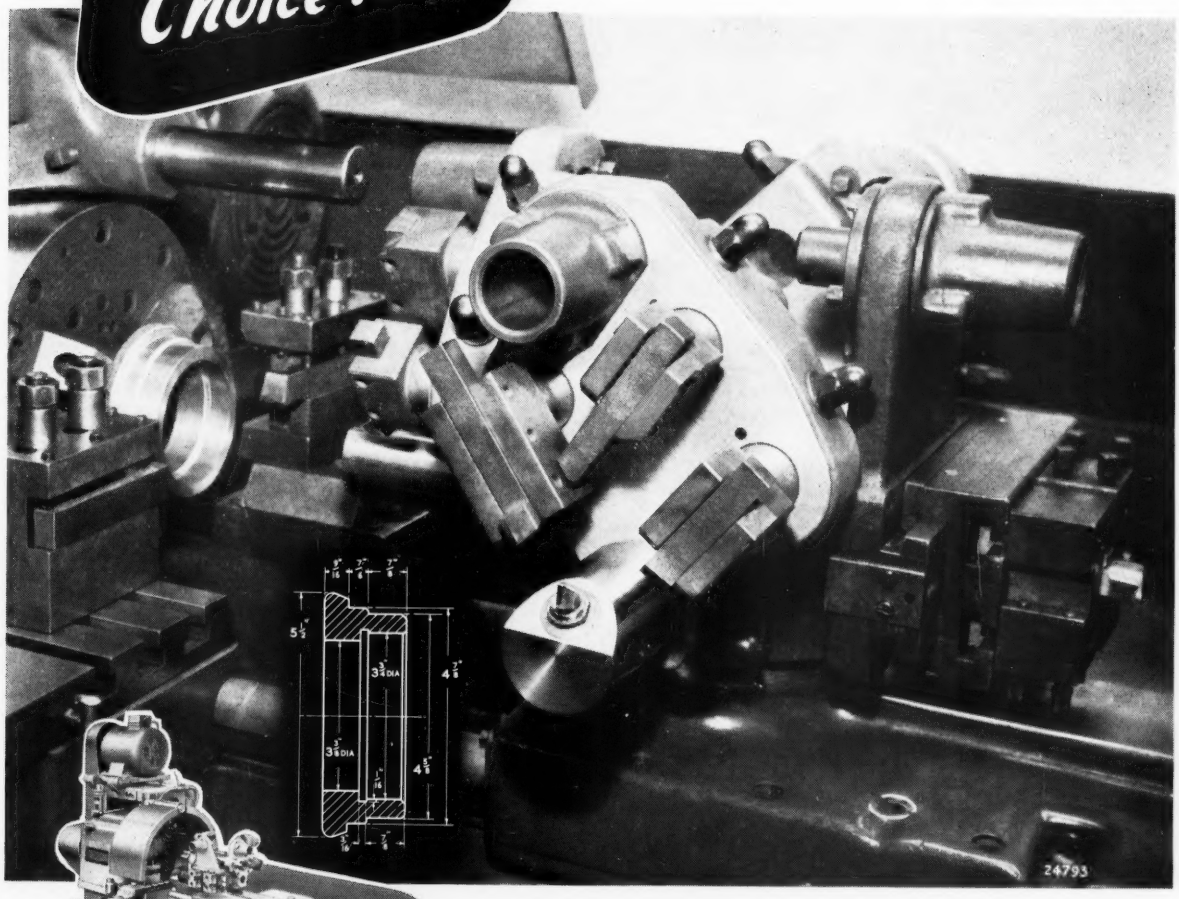
SLACK & PARR LIMITED

(MACHINE TOOL DIVISION 4)

KEGWORTH · NR DERBY · ENGLAND

Phone Kegworth 306 Grams 'Parr' Kegworth

Your Automatic Choice..... HERBERT AUTO-LATHES



Tooling arrangement on a Herbert No. 3A Auto-lathe for the production of thrust plates from 0.45% carbon-steel forgings in a total time of 3.16 minutes each.

For high production repetition work with consistent accuracy.

Greatest output per foot of floor space at lowest labour cost per piece—one operator and one tool setter can keep from four to six machines in continual operation.

Power, rigidity and speed ranges to take full advantage of Ardoloy and other carbide tooling.

All operations except chucking and removing the work are entirely automatic.

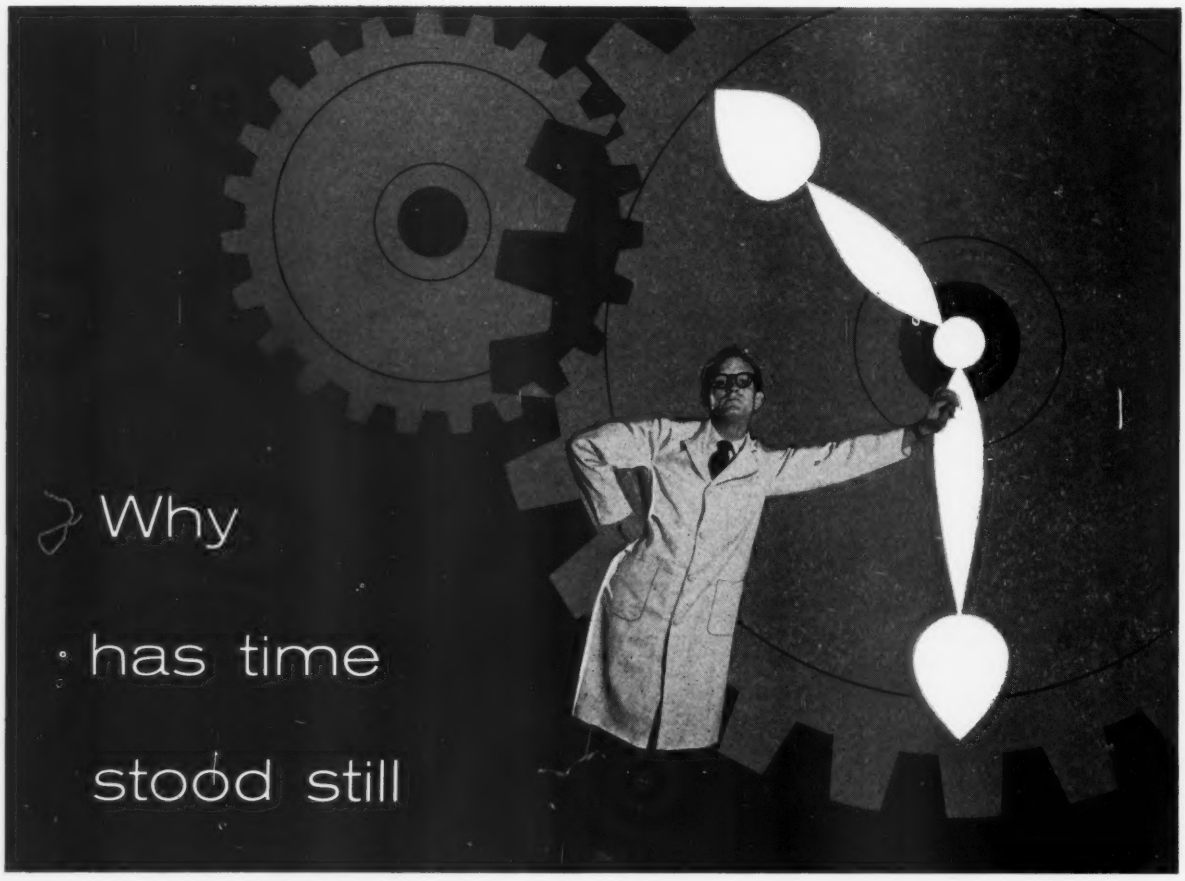
Made in four sizes : Auto Junior 8½" swing, No. 3A 12½" swing, No. 4—16½" swing and No. 5A—25" swing.

Available for Early Delivery

Ask for brochure "Production on Herbert Auto-lathes".

AD. 370

ALFRED HERBERT LTD., COVENTRY



in this corner of engineering ?

In your life as an engineer you've seen plenty of changes. Changes in techniques. Changes in planning and production methods. Changes in *all* aspects of engineering—except one.

But when you review the methods of fixing machines to the floor, you'll find there have been few real improvements in the technique over the last hundred—even two hundred years. Most heavy machinery is still bedded or bolted down; and while that practice lasts, so will the headaches it brings.

Bedding or bolting down makes the machines boss of the shop. They, not you, dictate production patterns. You've seen a production line idle while one breakdown is dug out. You've seen floor-space wasted because the floor won't stand drilling. You've seen work spoiled by structure-borne vibration. And while your machines stay immobile, you can't do a thing about it.

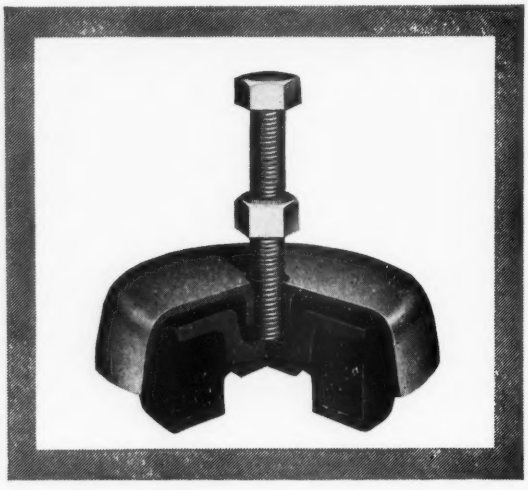
TIME FOR A CHANGE "Barrymount" Levelling Machine Mounts bring mobility to your machine shop. Machines stand free on them: they cannot 'walk', their vibrations are damped. Yet you can install new plant in minutes, even on floors that won't stand drilling. You can replace breakdowns, replan your entire line, just as quickly. You can even loan machines between shops for peak periods. No bolting, no shimming. No more work spoilage through vibration or operator fatigue.

Modern machine tools belong on

MADE IN ENGLAND UNDER LICENCE
BARRY B MOUNT
FROM BARRY CONTROLS INC. OF U.S.A.

LEVELLING MACHINE MOUNTS

"Barrymount" and "Barry B Mount" are Registered Trade Marks



Want to know more?

You are welcome to free, detailed literature from: CEMENTATION (MUFFELITE) LTD., 20 ALBERT EMBANKMENT, LONDON, S.E 11. (TEL: RELIANCE 6556)

NEVEN

There are no better diamond tools than those manufactured by Impregnated Diamond Products Limited of Gloucester.

. . . . ring Plannair . . . . tell them what you have in mind and your air movement problems are over. Plannair blowers — power for size the most effective of their kind in the world—have proved themselves outstanding in both the electronic and aircraft fields for applications involving either cooling or heating. And now, design engineers and manufacturers engaged in electrical and engineering practice have in this superb 8″ Plannair blower a new force with which to tackle their air movement problems. Technical data is in the next column. This blower and others in the Plannair range, together with this company's special ability in matters of air movement may be of considerable help to you. In that event, all you have to do is—get on to the blower: Leatherhead 4091

PLANNAIR BLOWER 8PL141-257

Blade tip diameter of impeller 8½″
Volumetric airflow 750 c.f.m. at a maximum pressure rise of 1·5″ w.g.
230 v. single phase 50c capacitor type 2,800 r.p.m.

PLANNAIR

PLANNAIR LIMITED · WINDFIELD HOUSE · LEATHERHEAD · SURREY

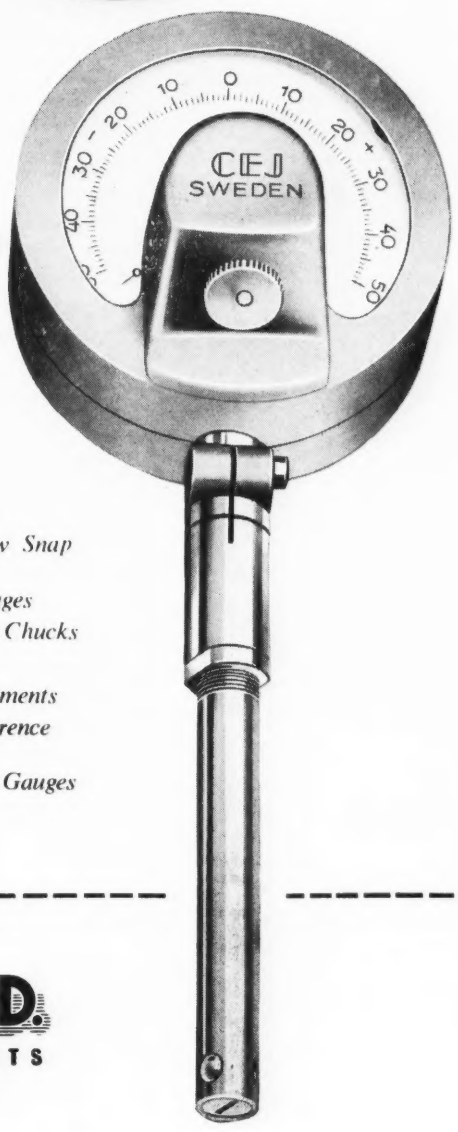
PLA11

CEJ

MIKROKATOR No. 500

A new smaller edition of the famous MIKROKATOR

Incorporates the same frictionless " twisted-strip " amplification, but designed for all applications where dial gauges would be used.



MIKROKATOR No. 548

This shows the new Mikrokator adapted for bore measurements by means of interchangeable measuring heads covering diameters from .125" to 1.00".

CEJ PRODUCTS

Ground Thread Taps
Chaser Dies
Screw Plug Gauges
Screw Ring Gauges
Circular Chasers and Holders
Round Dies
Thread Milling Hobs
Thread Rolling Dies
Plain Plug Gauges
Micro Snap Gauges
Surface Finish Indicators
Micrometers
Bore Gauges
Deltameters (Automatic Sizers)
Drill Chucks
Gauge Blocks
Dynamometers
Extensometers
Plain and Screw Snap Gauges
Plain Ring Gauges
Gronkvist Drill Chucks
Dial Gauges
Tapping Attachments
Multiple Interference Microscopes
Vernier Height Gauges

C.E. JOHANSSON LTD.

PRECISION TOOLS AND INSTRUMENTS

A.I.D. AND A.P.I. APPROVED

SOUTHFIELDS ROAD, DUNSTABLE, BEDS · TEL: DUNSTABLE 422/3

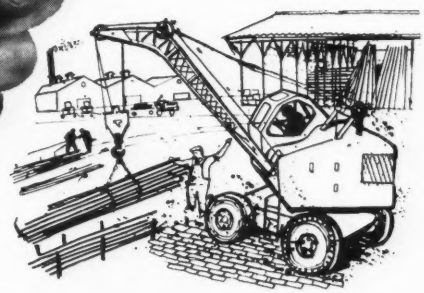
DHB/2364

a **C.T.B** insert

is more wear resisting than Tungsten Carbide

Glostics Ltd

AGENTS · **IMPREGNATED DIAMOND PRODUCTS LTD · TUFFLEY CRESCENT · GLOUCESTER**



FORD *POWER* for industry

Ford industrial engines are a practical proposition for many industrial equipments . . . **compressors, cranes, pumps, contracting equipment, earth borers, generators, railcars, welding plant, works trucks, tractors and conversions.** Simple design, modern flow-line production methods and common interchangeable parts contribute to the low cost of these high efficiency engines. And remember, *every* Ford engine is fully backed by a World-wide Spare Parts Service Organisation. Take your choice from a wide power range . . . Diesel 30 to 86 b.h.p. and Petrol 21 to 87 b.h.p. (12-hr. rating).

DIESEL ECONOMY—have you considered the replacement of existing power units in your equipment and trucks with the famous Ford 4D Diesel engine? You'll have the unique advantages of economy, long-life and low running costs . . . plus the best service in the World!

Wherever you are, whatever your problem, we are at your service. For further details of

FORD **INDUSTRIAL ENGINES**

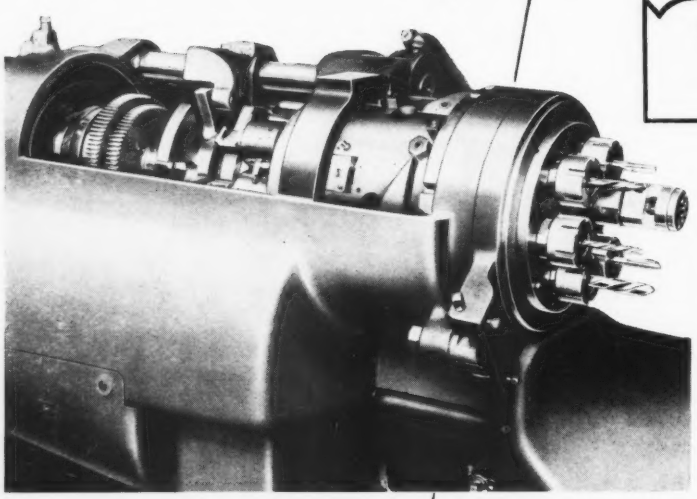
and the equipments they power, contact your nearest Ford Dealer or write to

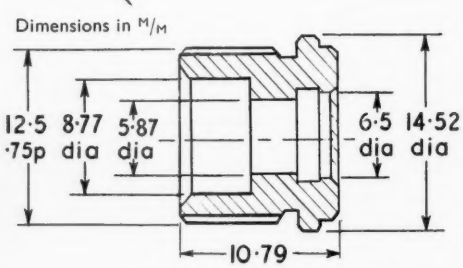
FORD MOTOR COMPANY LTD · PARTS DIVISION · AVELEY DEPOT · SOUTH OCKENDON · ROMFORD · ESSEX · ENGLAND

PETERMANN P16

single spindle Automatic with six spindle.....

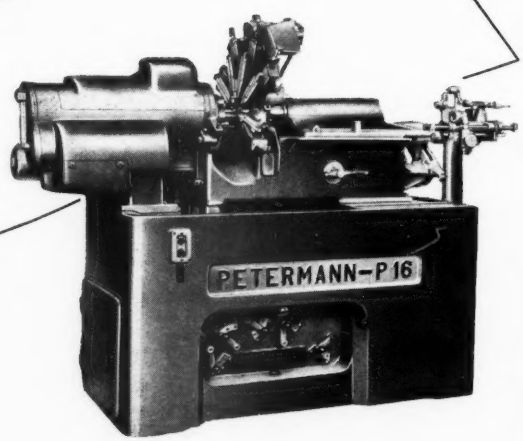
TURRET





CYCLE TIME 16·5 SECONDS
This brass fuse is machined at 635 ft. per minute.

The new Petermann Turret considerably increases the range of components which can be completely machined in one operation. Its six spindles either rotating or stationary, provide greater facilities for drilling, threading or tapping.



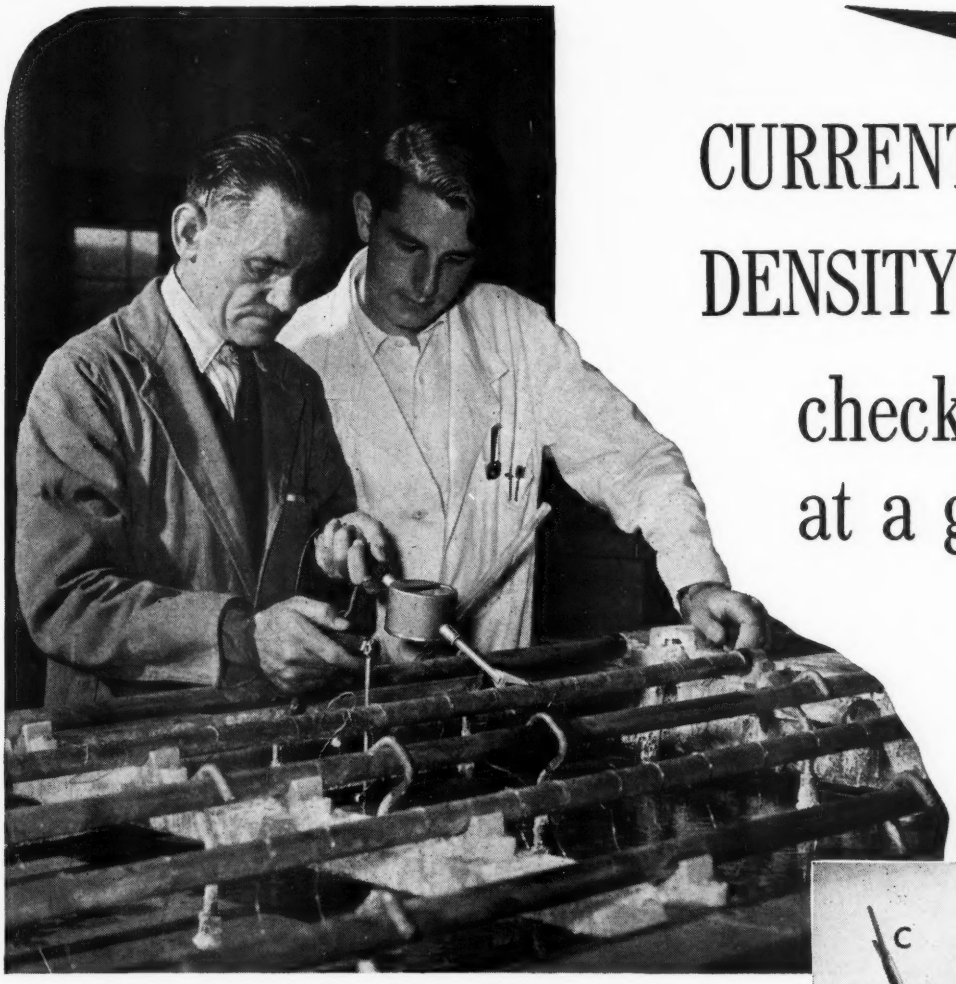
The Petermann Automatic (capacity 16 m.m.) with its six transversal tools and its turret with multiple combinations of six spindles offer the easy solution of a considerable number of automatic tooling problems.

CHARLES **CHURCHILL** & CO LIMITED

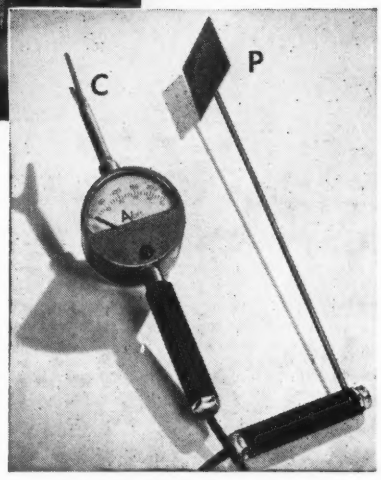
COVENTRY ROAD SOUTH YARDLEY BIRMINGHAM 25

BRANCHES LONDON GLASGOW NEWCASTLE MANCHESTER

BAS CC RR



CURRENT DENSITY checked at a glance



The 'ENGLISH ELECTRIC' current density indicator gives:

- **A quick reading of the amperes per square foot flowing in the electrolyte.**
- **A much greater accuracy of indication than has previously been possible.**

The electrode 'P' is immersed in the vat between the component to be plated and the anode, and the forked contact 'C' is pressed on to the work bar. The current density is then indicated directly on the specially calibrated ammeter.

Any number of plating vats can be checked quickly so that their operating currents may be adjusted for maximum plating efficiency and consistency of quality.

Send for publication MS/4017 to Meter, Relay and Instrument Division.

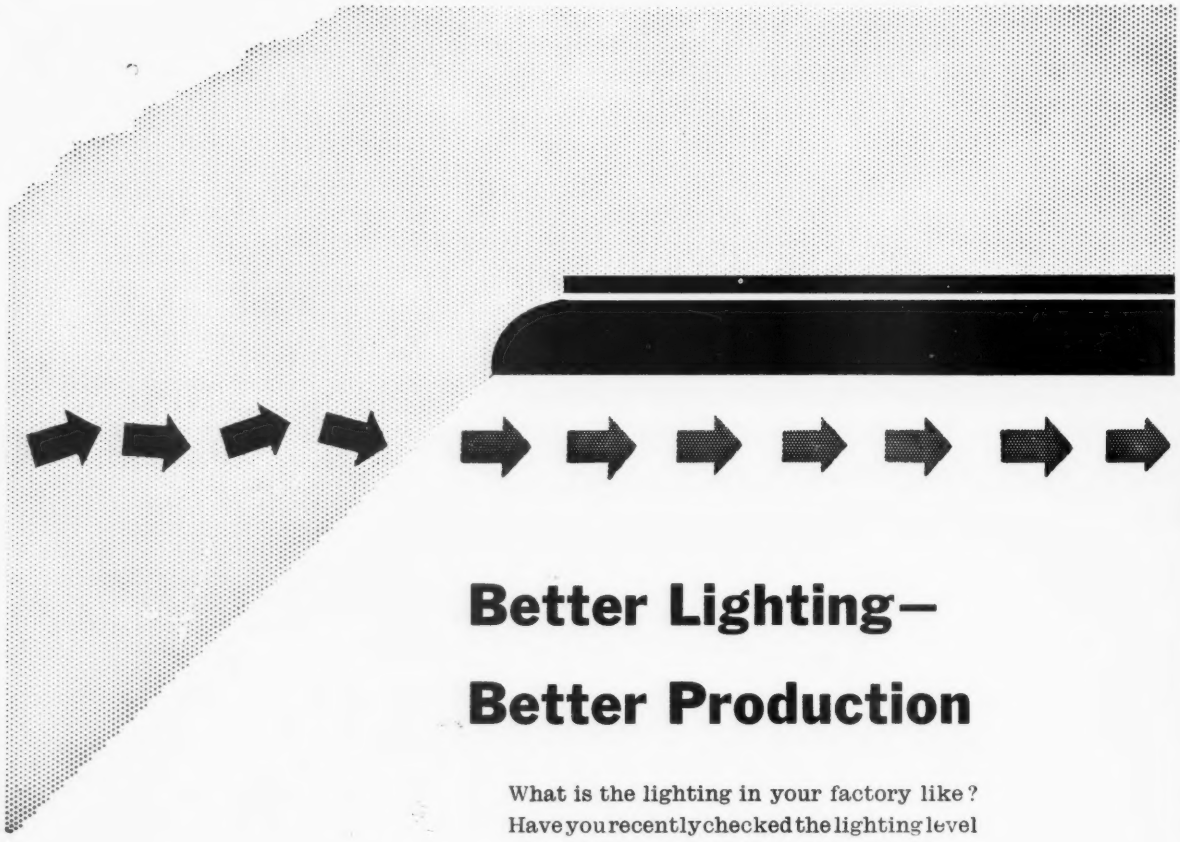
'ENGLISH ELECTRIC'
current density indicator

THE ENGLISH ELECTRIC COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2

Meter, Relay and Instrument Division, Stafford

WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

INS. 32/7



Better Lighting—
Better Production

What is the lighting in your factory like? Have you recently checked the lighting level round the works with a light meter?

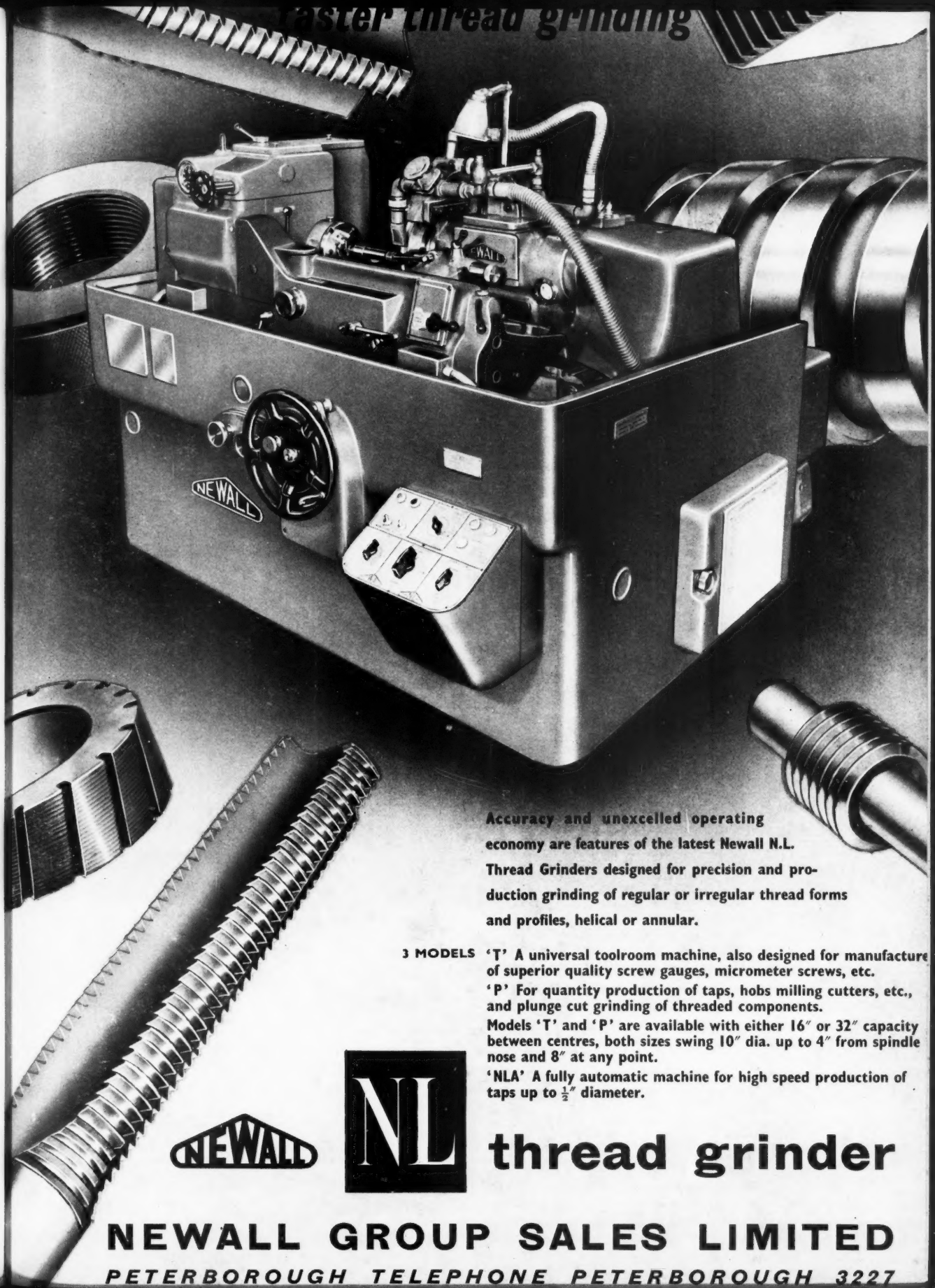
The *right* lighting has a significant effect on the speed and accuracy of production. When its strength, position and type is suitable for each job the craftsman can give full play to his skill, and the works engineer can do full justice to his shop.

Good lighting is only one of the many ways in which electricity is playing a vital part in the drive for higher productivity.

Electricity for Productivity

Ask your ELECTRICITY BOARD for advice and information, or get in touch with E.D.A. They can lend you, without charge, films about the uses of electricity in industry. E.D.A. are also publishing a series of books on Electricity and Productivity. Titles now available are: Lighting in Industry, Electric Resistance Heating, Electric Motors and Controls, Higher Production, Materials Handling, and the latest addition to the series, Induction and Dielectric Heating. Price 8/6, or 9/- post free.

Issued by the
British Electrical Development Association
2 Savoy Hill, London, W.C.2



Accuracy and unexcelled operating economy are features of the latest Newall N.L. Thread Grinders designed for precision and production grinding of regular or irregular thread forms and profiles, helical or annular.

3 MODELS

'T' A universal toolroom machine, also designed for manufacture of superior quality screw gauges, micrometer screws, etc.

'P' For quantity production of taps, hobs milling cutters, etc., and plunge cut grinding of threaded components.

Models 'T' and 'P' are available with either 16″ or 32″ capacity between centres, both sizes swing 10″ dia. up to 4″ from spindle nose and 8″ at any point.

'NLA' A fully automatic machine for high speed production of taps up to $\frac{1}{2}$″ diameter.

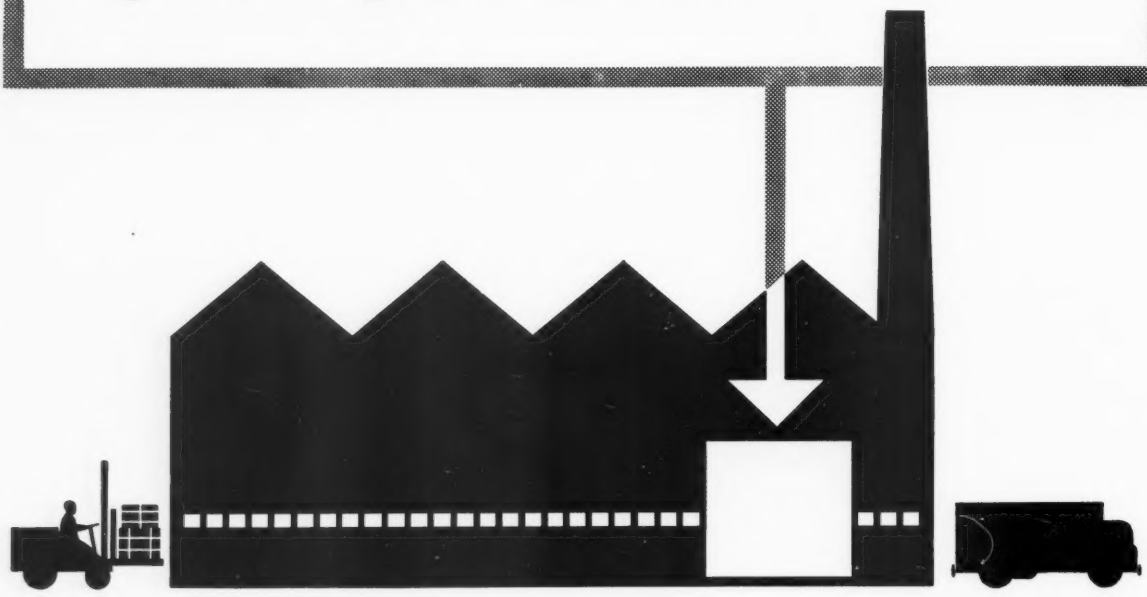
NEWALL NL **thread grinder**

NEWALL GROUP SALES LIMITED

PETERBOROUGH TELEPHONE PETERBOROUGH 3227

AUTOMATION OR OTHERWISE

let Wild-Barfield fit heat-treatment into your production line



More and more production engineers are finding that the installation of Wild-Barfield continuous furnaces speeds up production flow and helps to cut costs. By bringing heat-treatment right into the production line, delays and wasteful handling are eliminated. Wild-Barfield make a wide range of continuous furnaces for normalising, hardening, tempering, carbonitriding, bright annealing and other applications. All are built to the highest standards of workmanship to meet the requirements of production engineers and metallurgists. The Wild-Barfield Research Department is available to advise on your heat-treatment problems.

ELECTRIC WILD BARFIELD FURNACES

FOR ALL HEAT-TREATMENT PURPOSES

WILD-BARFIELD ELECTRIC FURNACES LIMITED

ELECFURN WORKS, OTTERSPOOL WAY, WATFORD BY-PASS, WATFORD, HERTS. Telephone: Watford 6091 (8 lines)

WB37

Typical

HIGH TENSILE STEELS

by **FIRTH BROWN**

ALLOY STEELMAKERS · FORGEMASTERS · STEEL FOUNDERS · HEAVY ENGINEERS

THOS. FIRTH & JOHN BROWN LIMITED · SHEFFIELD · ENGLAND

HALL MARKS of FINE STEELS

Consistent high quality during many generations of manufacturing has secured a reputation as hallmarks of fine steels for the various brands produced by Samuel Osborn & Co., Limited.

Production methods, blending traditional skill with modern technology, ensure that these high-speed tool, alloy, manganese, stainless and heat-resisting steels will satisfy the most exacting standards.

"TITAN" "MUSHET"

"TROPIC"

CUTTER

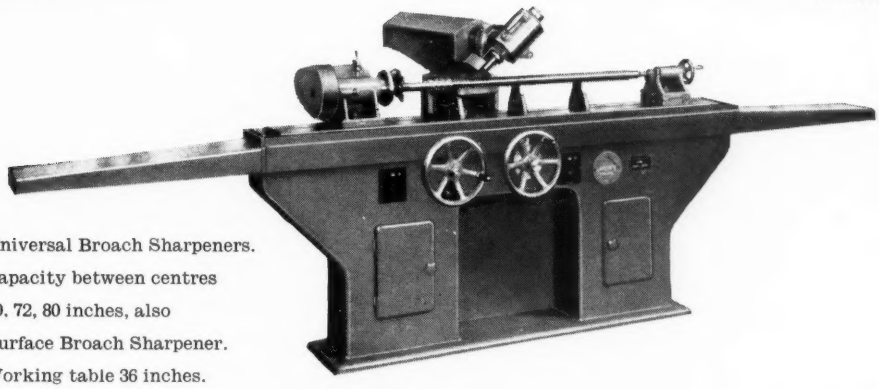
OSBORN

FINE STEELMAKERS · STEELFOUNDERS · ENGINEERS' TOOLMAKERS

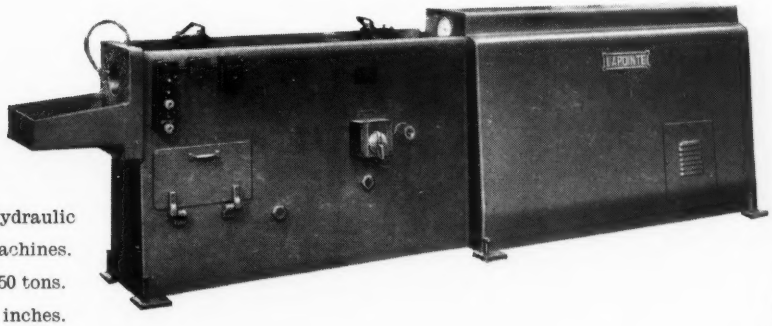
SAMUEL OSBORN & CO., LIMITED
CLYDE STEEL WORKS, SHEFFIELD

come to

LAPOINTE **for better broaching**



Universal Broach Sharpeners.
Capacity between centres
60, 72, 80 inches, also
Surface Broach Sharpener.
Working table 36 inches.



Horizontal Hydraulic
Broaching Machines.
Capacity: 2½-50 tons.
Stroke: 30-78 inches.

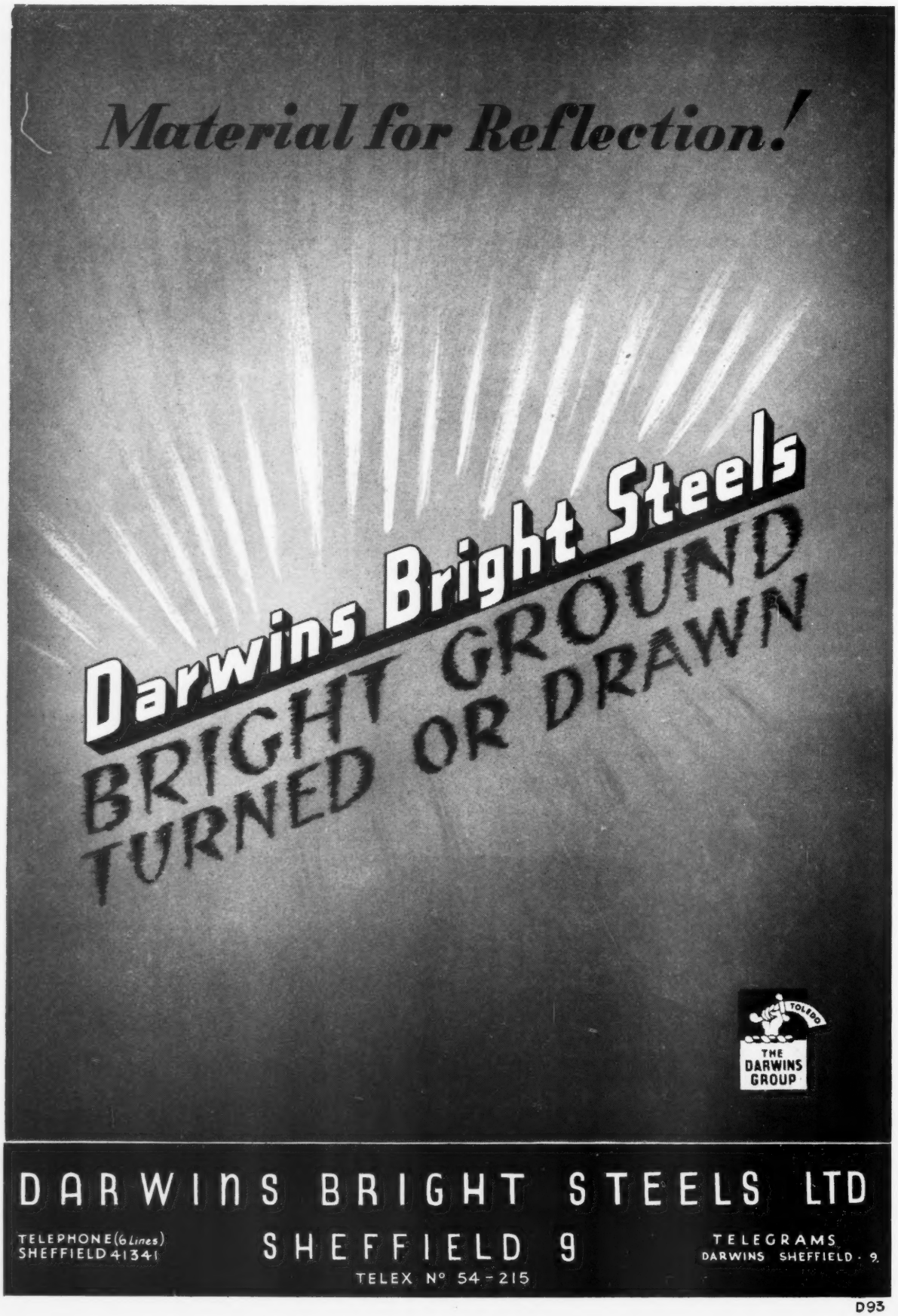
British Made

The Lapointe Machine Tool Co Ltd

Otterspool Watford-by-Pass Watford Herts

Telephone Gadebrook 3711 *(4 lines)* Cables Lapointe Watford

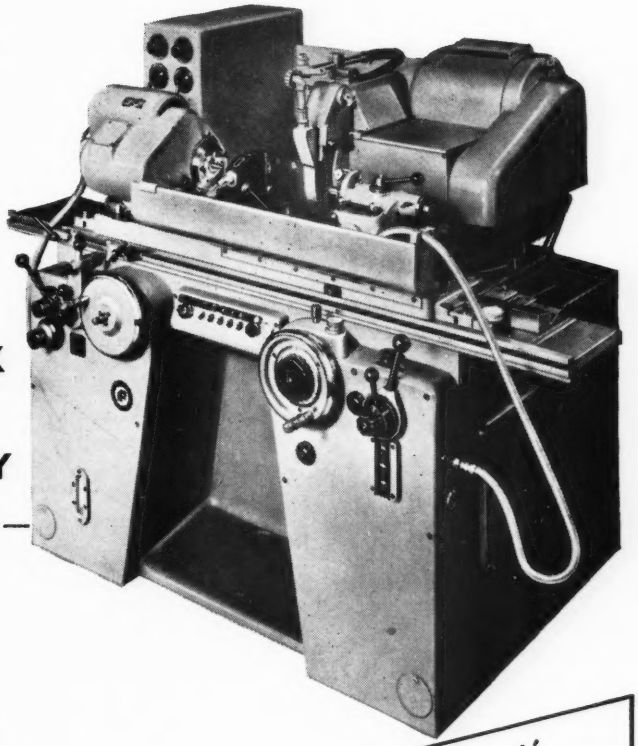
Also The Lapointe Machine Tool Company Hudson Mass. USA


Material for Reflection!
Darwins Bright Steels
BRIGHT GROUND
TURNED OR DRAWN
TOLEDO
THE DARWINS GROUP
DARWINS BRIGHT STEELS LTD
TELEPHONE (6 Lines)
SHEFFIELD 41341
SHEFFIELD 9
TELEX Nº 54-215
TELEGRAMS
DARWINS SHEFFIELD · 9.
D93

accuracy *productivity* *versatility*

are all features of the range of Precision Grinding Machines built by_____

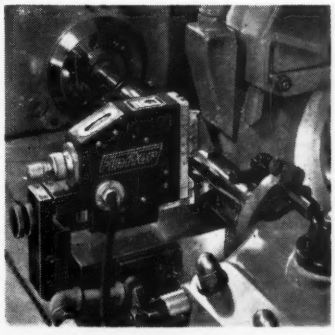
FORTUNA-WERKE
SPEZIALMASCHINENFABRIK
A. G. STUTTGART
BAD CANNSTATT GERMANY



For Toolroom and Production

Illustration shows Model AFB, one of the wide range of types available in 2 sizes, 5.5/16 height of centres, 12" and 20" maximum distance between centres. Can be arranged as plain, universal or automatic machine and with infinitely variable wheel speed.

Automatic Sizing



With FINITOR Automatic size control the measuring head which controls the cycle of the machine is in constant direct contact with the work during grinding.

Accuracy is thus independent of all variables inherent in the grinding operation.

Rainbow 1555

VAUGHAN
ASSOCIATES LIMITED

4 QUEEN STREET · CURZON STREET · LONDON · W.1 Tel: GROsvenor 8362

Midland Office and Demonstration Room: **WILFORD CRESCENT · NOTTINGHAM** Tel: **NOTT 88008**

BUILT FOR SMALL DIAMETER COMPONENTS

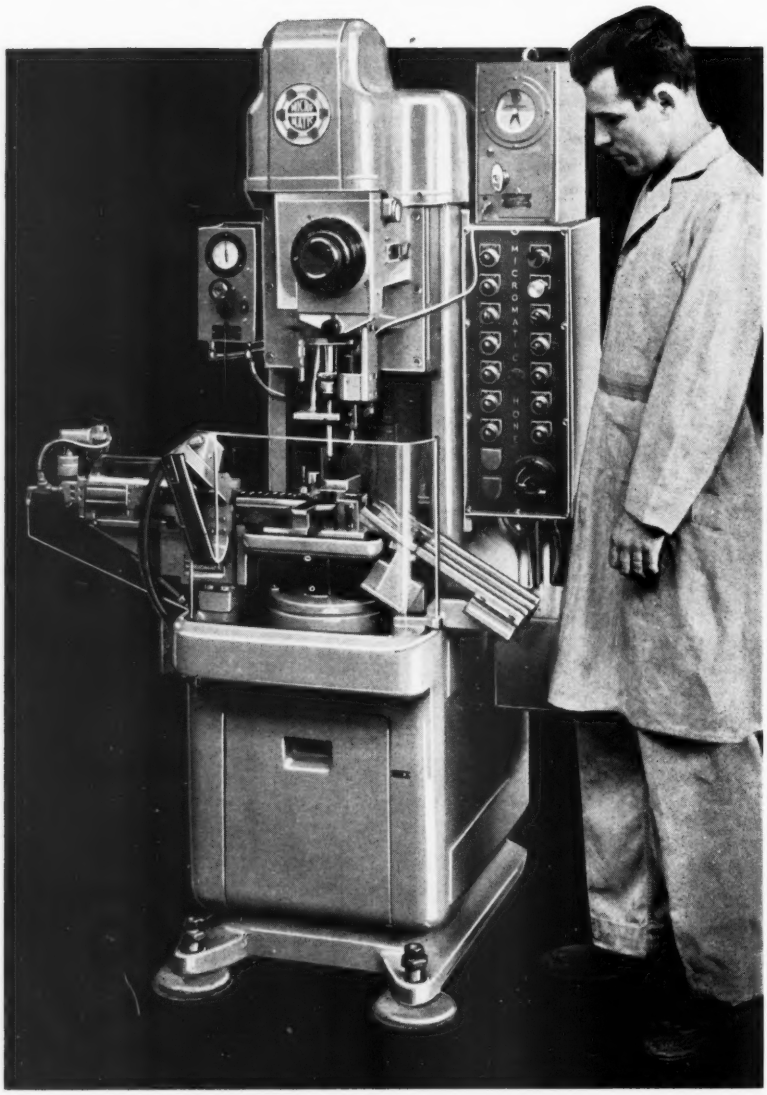
MICRO MATIC

Jones-Shipman
MODEL 738 MICROHONER

This model has recently been introduced to meet the demand for a honing machine to accommodate small diameter components for honing bores from $\frac{1}{4}''$ to $1''$ diameter.

The Model 738 can be offered in two types, as a **simple hand feed machine,** or **fully automatic,** for sizing the bores, gauging and segregating according to tolerances required.

Micromatic Products are made and sold by us under U.S. Licence.



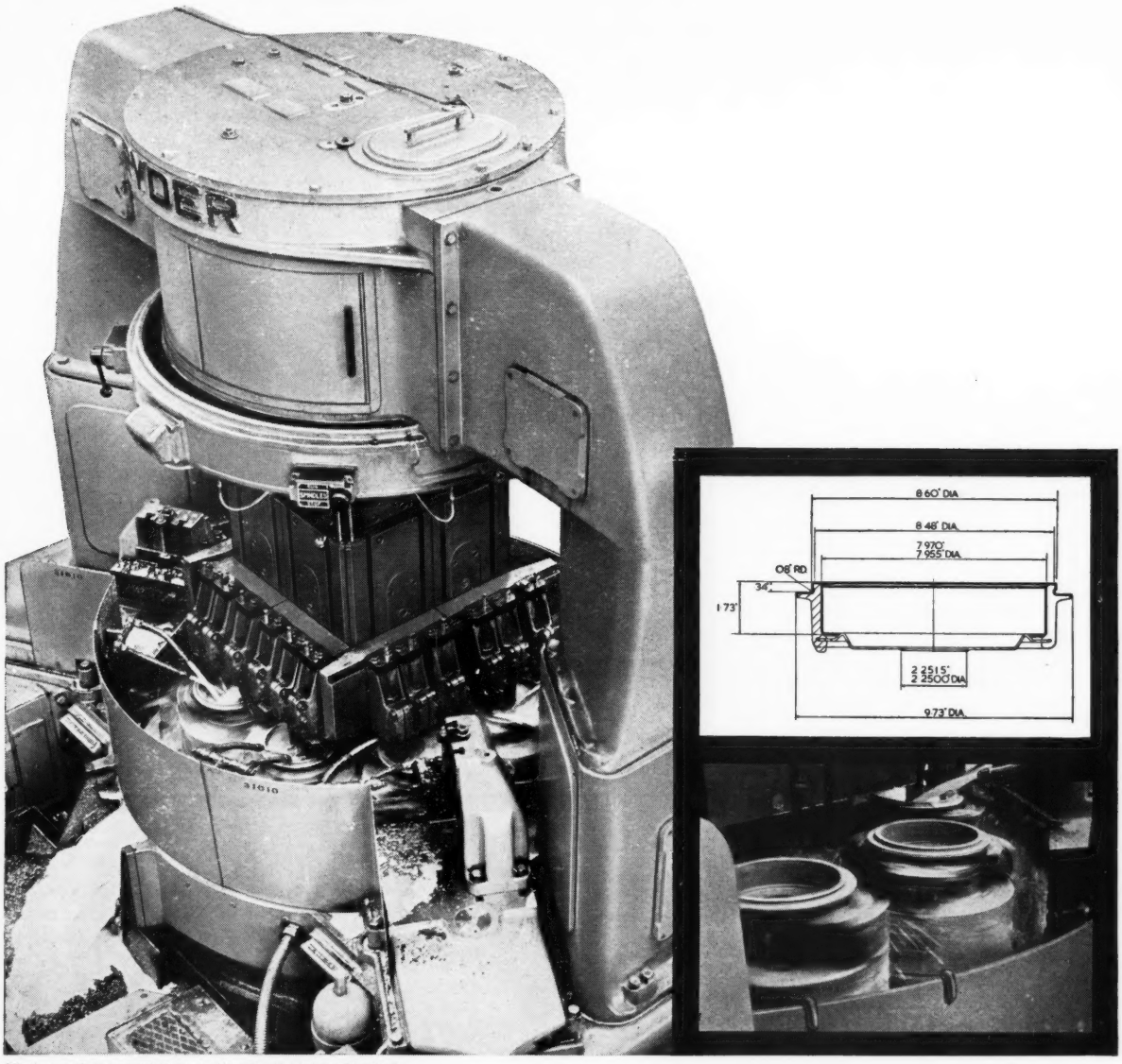
A. A. JONES & SHIPMAN LTD.

NARBOROUGH ROAD SOUTH, LEICESTER

Telephone: 823222 (8 lines) Telegrams: 'CHUCK', Leicester

London Office: Murray House, 5 Vandon Street, Buckingham Gate, S.W.1

Telephone: ABBey 5908 (2 lines)



Photograph by permission of Vauxhall Motors Limited.

A Vauxhall brake drum machined in seconds!

Double Indexing 8-spindle Verticalautos produce Vauxhall Brake Drums at the rate of 110 per hour per machine. The controlled gripping pressure of the hydraulic chucks eliminates distortion, and the 60 H.P. Main Motor provides ample power for continuous high production.
Six and Twelve spindle machines are also available.

Ryder VERTICALAUTO

Thos. Ryder & Son Limited, Turner Bridge Works, Bolton, England.
Makers also of single spindle Rydermatics and Piston Ring Lathes.

STORAGE
SPRAY
JACKETED
CHEMICAL
MIXING
HEATER
LEAK TEST
COOLER
REACTION
LINEN
SEPARATOR
HYDRO
ROAD WAGON
CONDENSE
OIL
ACID
FUEL

TANKS and VESSELS

of all types for all purposes

We offer an unequalled service in the design and fabrication of this highly specialised class of equipment. If you have any problem involving bulk storage, handling, conveyance or processing of liquids at normal or maintained temperatures, it is possible that we could save you considerable worry, much time and money.

PRESSURE
VACUUM
FILTER
MIXING
REACTION
ACID
JACKETED

HELMSMAN PRODUCTS

W·B·BAWN & COMPANY LIMITED

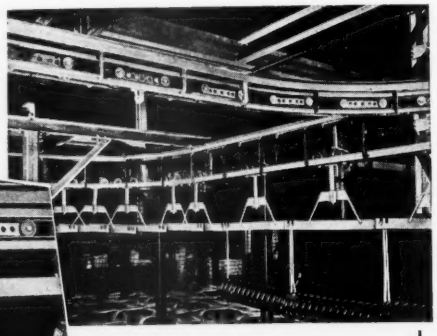
BYRON WORKS, BLACKHORSE LANE
LONDON, E.17 · LARkswood 4411/4

IT PAYS TO COME TO BAWN'S FIRST!

Keeping Industry Rolling!

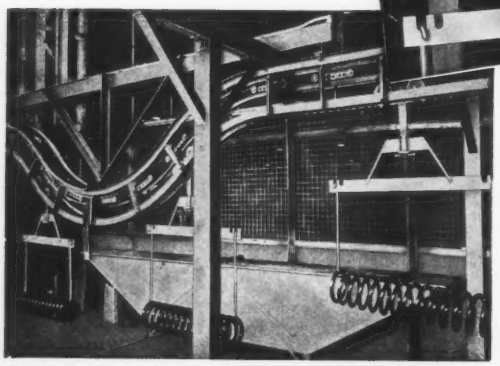
TELEFLEX
CONVEYOR INSTALLATION
for
Leyland
MOTORS LTD.

Photographs by courtesy of Leyland Motors Ltd.



1

2



3

This is a Teleflex Chain Creeper Conveyor used for transportation through spraying and foundry processes. Each carrier is suspended from a heavy duty trolley running in a subsidiary track which, in Illustration 1, is shown diverting from the driven portion of the Conveyor.

The carrier when diverted can be gravitated and traversed by hand and then pushed into the moving circuit, where it is picked up by a driving dog assembled in the link of the driving chain.

Illustration 2 shows trolley travelling towards a stoving oven. Illustration 3 demonstrates how the Chain Creeper Conveyor is made to elevate over a comparatively short distance.

Full details of Teleflex Conveyors on request.

TELEFLEX PRODUCTS LIMITED
CHADWELL HEATH · ESSEX
'Phone: Seven Kings 5771 'Grams: Teleflex, Phone, Romford

ALSO MANUFACTURERS OF THE WORLD RENOWNED TELEFLEX CONTROLS

And we want the new grinder complete with a

Philips Universal Clarifier

It pays to specify a Philips Universal Clarifier when you're buying a new grinder. Successfully proved in service on virtually every type of machine, the Philips Clarifier cuts costs by economising on coolant, increasing wheel life, improving surface finish of product, and reducing maintenance time. Philips technical staff are available throughout the country to give advice and assistance. Please write or 'phone for further information.

when you buy a grinder specify a

PHILIPS

PHILIPS

Universal Clarifier

Most well-known manufacturers will supply their machines to you complete with a Philips Universal Clarifier, if specified. They include: B.S.A., Browne & Sharpe, Churchill, Cincinatti, Craven, Hartex, Jones and Shipman, Keighley, Lumsden, Naxos, Newall, Orcutt, 'Precimax', Scrivener, Snow.

PHILIPS THE DEPENDABLE FILTERS

FILTRATION DEPARTMENT. PHILIPS ELECTRICAL LTD.. INDUSTRIAL PRODUCTS DIVISION, Century House, Shaftesbury Avenue, London, W.C.2 *Tel: GERrard 7777*
(PI0241A)

what are you waiting for?

You want Precision Hobs? We can supply them! Spur, helical, worm wheel, spline or serration, made precisely to your requirements.

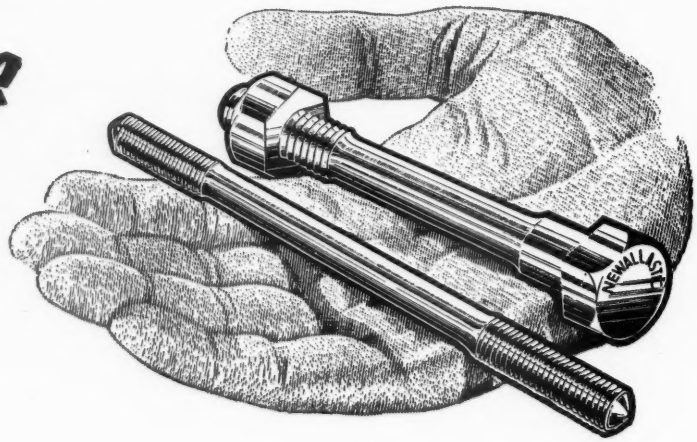
Our standard Spur and Helical range is designed to cover all normal requirements and to give you speedy deliveries, in many cases actually from stock.

If you have not been using David Brown Precision Hobs, write now for Leaflet E313.9 and get yourself acquainted with our quality and our service.

THE
DAVID BROWN
CORPORATION (SALES) LIMITED
TOOL DIVISION
PARK WORKS HUDDERSFIELD

Unique

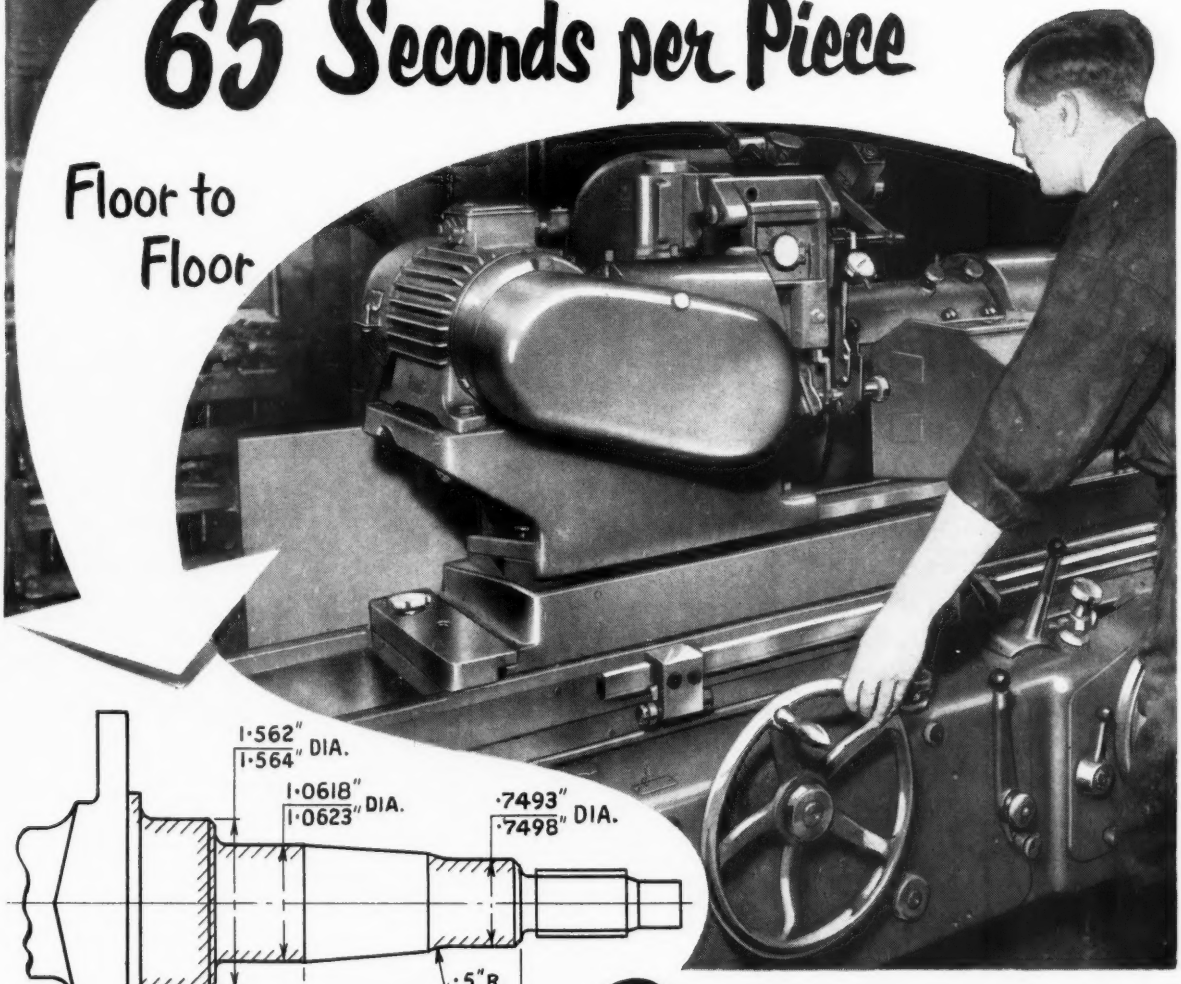
"Newallastic" bolts and studs have qualities which are absolutely unique. They have been tested by every known device, and have been proved to be stronger and more resistant to fatigue than bolts or studs made by the usual method.

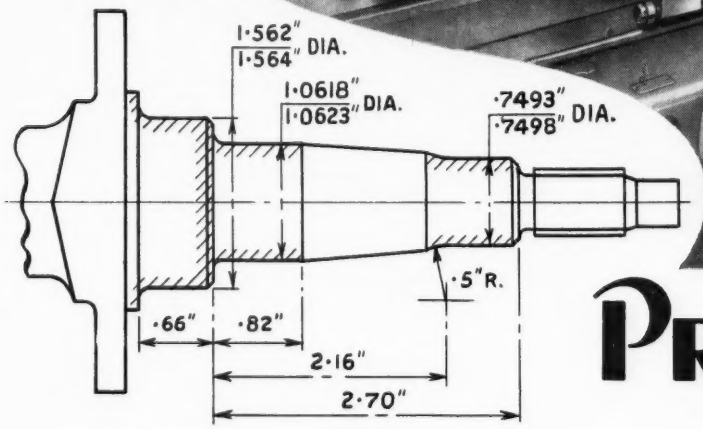


C. P. Newall & Co., Ltd.
POSSILPARK GLASGOW · N

65 Seconds per Piece

Floor to Floor





GROUND WHERE MARKED //////
PART VIEW OF COMPONENT

PRECIMAX Grinding

Stub Axles at Armstrong Patents Ltd.

The key to this outstanding production achievement is plunge grinding on the PRECIMAX model MPB 12/24. The stub axle shown in the drawing is of 80-ton tensile mild steel and amongst the many PRECIMAX features contributing to ultra high speed performance is the accurate dressing of the wheel allowing the simultaneous grinding of three diameters.

PRECIMAX Grinding Machines are available in a wide range of types and sizes.

Our range includes precision fine boring machines as well as grinding machines. Send for full details.

JOHN LUND LIMITED, EASTBURN WORKS, CROSS HILLS, Nr. KEIGHLEY. 'Phone : Cross Hills 3211 (3 lines)

Be right in the CENTRE

SUPER CENTRE

A permanent Hardened and Ground Socket with RENEWABLE HIGH SPEED STEEL INSERT. Standard inter-changeable inserts enable centre to be quickly replaced.

STANDARD SOLID CENTRES

Precision ground to give perfect concentricity. Tapers to standard gauges. Made in High Grade CARBON ALLOY STEEL, or HIGH SPEED STEEL BUTT WELDED.

THE ARCHER REVOLVING CENTRES

Revolve with the work and can thus stand up to the higher speeds and heavier work demanded by modern engineering practice.

★ *Ask for Lists Nos. 50B and 85.*

ARCHER SMALL-TOOLS

ARCHER

BALL & ROLLER BEARING TYPES

REVOLVING CENTRES

All types of centres are made from the best grade steel, and are designed to give greater efficiency, take higher speeds, and remain true under the most strenuous conditions.

FRANK GUYLEE & SON LTD

ARCHER TOOL WORKS · MILLHOUSES · SHEFFIELD

Telegrams: "Guylee, Sheffield". Telephone: 50061-50062

H.S.S. MILLING CUTTERS & REAMERS

In addition to the well-known 'Galtona-O.K.' Serrated Blade Cutters, we supply all types of solid high-speed steel milling cutters, including face and end mills, cylindrical cutters, side and face mills, saws and form relieved cutters. Boring tools are also available including core drills, parallel and taper reamers, shell reamers, counterbores, etc.

Popular sizes ex stock. Enquiries invited.

Richard Lloyd Limited

GALTON HOUSE, ELMFIELD AVENUE, TYBURN, BIRMINGHAM, 24

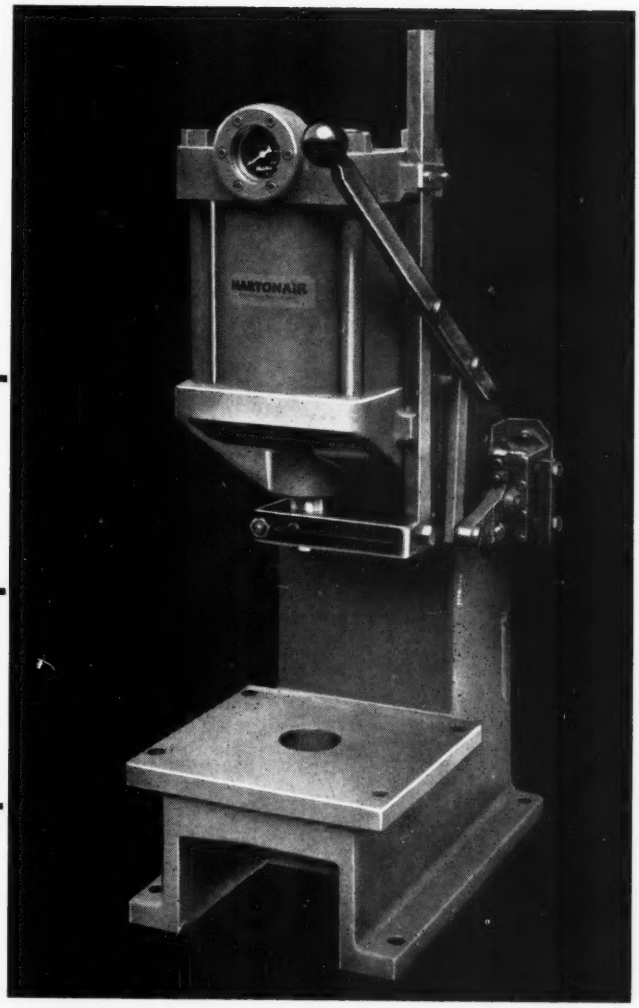
Telephone: Ashfield 1801, Telegrams "Cogs, Birmingham"

Northern Area Office: A. V. GREEN, BRITANNIA HOUSE, WELLINGTON STREET, LEEDS, 1.

London Area Office: A. J. PERCY, 240, ROMFORD ROAD, FOREST GATE, LONDON, E.7.

F/4/5

The right pressure, in the right place, at the right time!



THE

Martonair

ONE TON SERVO PRESS

This powerful and compact press has an extremely wide range of applications for small stampings, assembly, bush pressing, etc.

Servo control ensures that the pressure exerted on the ram is directly proportional to the manual pressure applied to the operating lever. This arrangement gives the same accuracy of speed, position and pressure control as with a lever operated press, but with greater pressure and less effort. Moving the fulcrum pin gives servo/manual pressure ratios 100 : 1, 50 : 1 and 25 : 1.

A similar press, S.480/2, is available, without servo control, but fitted with a two-handed safety control valve, which requires both push-buttons to be depressed simultaneously before the press will operate.

Full catalogue on request from

MARTONAIR LIMITED, PARKSHOT, RICHMOND, SURREY, ENGLAND

Tel— RICHMOND 3348

MANUFACTURERS OF PNEUMATIC HOISTS—MINOR, STANDARD AND HEAVY DUTY CYLINDERS—THE WORLD'S LARGEST RANGE OF CONTROL VALVES—AND ACCESSORIES FOR EVERY PHASE OF APPLIED PNEUMATICS

AD16

Cyclopean

This term is applied to rude masonry, to walls constructed of unhewn stone, and to the rough stoneworks of the Early Greeks and Etruscans. In its broad sense, it is used to describe any crude, elementary building. Any term used to describe the Marsh CYC Drill would, of course, be the antithesis of the word Cyclopean, for the Marsh CYC Drill is renowned for the perfection of its craftsmanship.

Marsh CYC twist drills

MARSH BROTHERS & CO. LIMITED · SHEFFIELD · ENGLAND

High speed turning of high tensile steels

Bar turning by the Cross Chord clamp tipped tool, in which a tungsten carbide cutting edge is inclined to 50° to the axis of the work, offers the following unique combination of advantages:

Exceptional results on all materials up to the highest tensile strength

Longer tool life at higher speeds

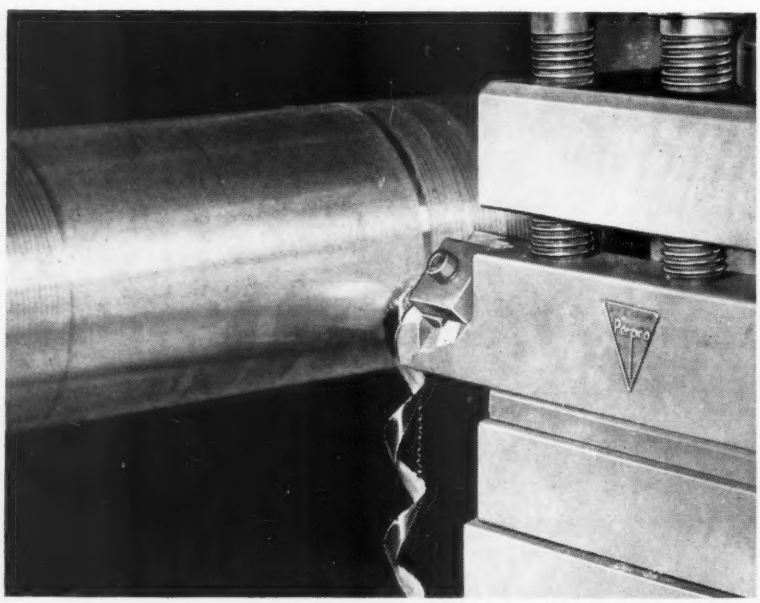
Improved work surface finish

Floor-to-floor times reduced by at least 50%

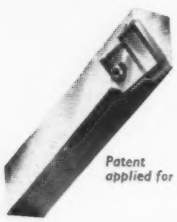
Four interchangeable cutting edges

High modulus carbide shank greatly increases rigidity

We shall be pleased to advise you on suggested applications for this tool and the services of our Chief Demonstrator are available to demonstrate the Cross Chord in your own works.



Cross Cross tool cutting S.96, 80-ton steel at 600 ft./min. Depth of cut 0.035 in., feed 0.06 in./rev. By permission of the College of Aeronautics.



PRODUCTION TOOL ALLOY CO. LTD.

HARLINGTON WORKS, SHARPENHOE, BEDFORD.

Telephone: Toddington 315-6-7 Telegrams: Perpro Luton Telex: 14-625

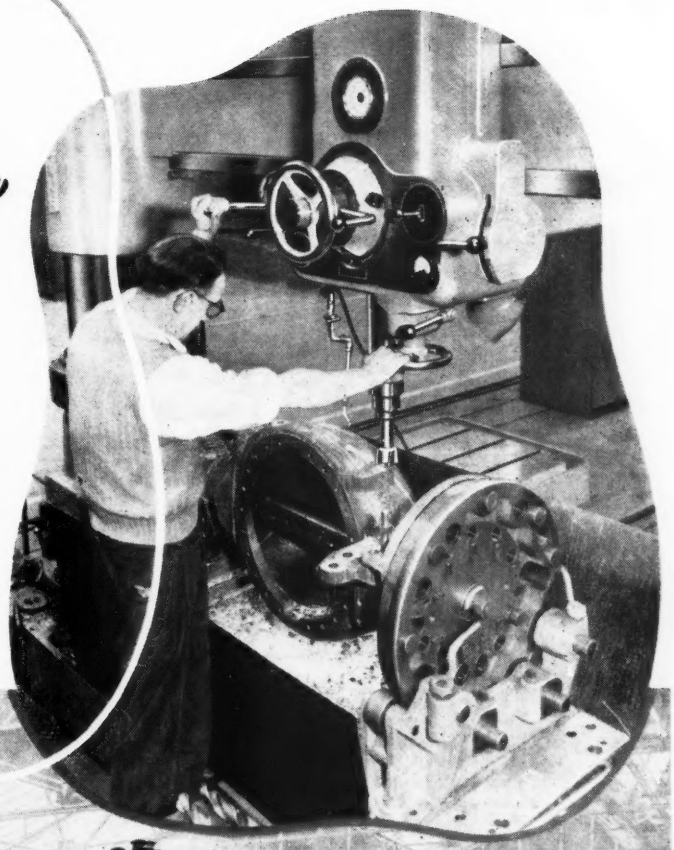
Perpro

AP30

"Greater operating speeds"

.... say 'EUCLID'

Special indexing fixtures are used by Euclid (Great Britain) Ltd., to ensure the efficient drilling, tapping and spot facing of the many holes in these heavy duty rear axle casings. Included with sound planning and tooling in their formula for maximum efficiency, are the ARCHDALE MECHANICAL AND HYDRAULIC "PRESELECTS", which offer such unique advantages as—22 spindle speeds and 18 rates of feed, all preselected at any time with the spindle stationary or running. Capacity: 3½" dia., in M.S. Speeds: 11 - 1,450 r.p.m. Feeds: 8 - 540 r.p.i. Built in sizes from 5' to 12' spindle radius. Write for full details.



ARCHDALE "pre-select" RADIALS

JAMES ARCHDALE & CO. LTD., LEDSAM STREET, BIRMINGHAM 16

SOLE AGENTS: ALFRED HERBERT LTD. COVENTRY

Square cutting a rug!

You should have seen our Oldest Hand's face as he watched the lads and lassies rocking and rolling at the works dance. Finally he turned and walked to the bar.

"Going to cut a rug with me, Gran'pa?" the Canteen Manageress smiled.

"Well, if I'm going to cut anything, dear, I'll need a pint of Sternosol-Six * first!"

* *Sternosol-Six soluble oil and a full range of straight cutting oils are described in our booklet PSS638*

Sternol *Cutting Oils*

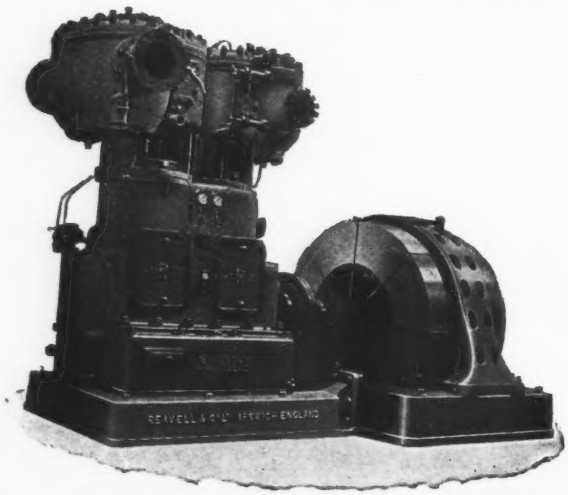
STERNOL LIMITED, ROYAL LONDON HOUSE, FINSBURY SQUARE, LONDON, E C.2. Tel: MONarch 3871-5.

WHEN YOU ARE WANTING NEW

AIR COMPRESSORS

DO NOT FORGET THAT WE HAVE

A COMPLETE RANGE TO SUIT ALL DUTIES



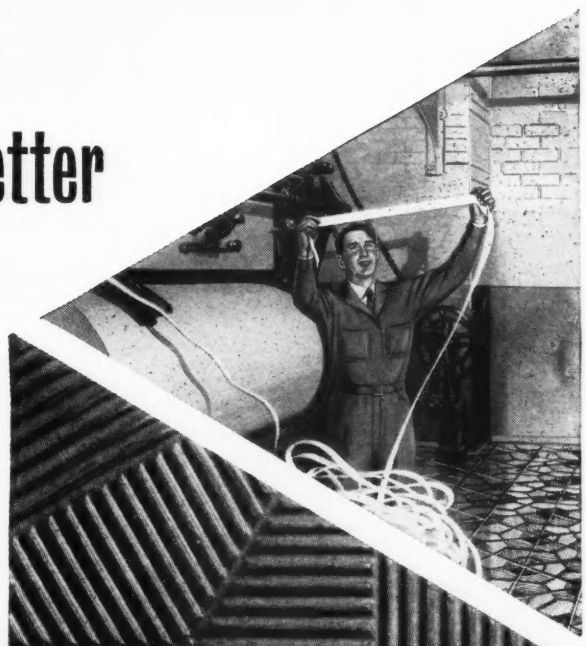
Whatever it is you need—large or small capacity—high or low pressure—we can supply the best machine for the purpose, and our fifty years of specialised experience are at your service.

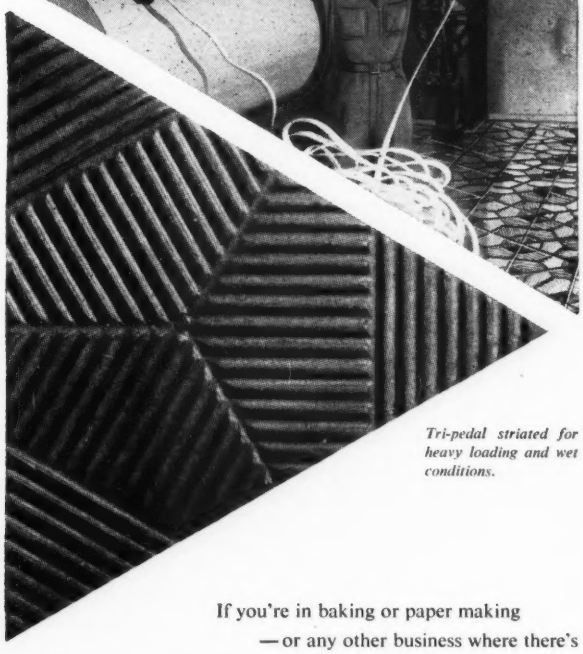
REAVELL & CO. LTD.

IPSWICH

Telegrams: Reavell, Ipswich Telephone Nos.: 2124-5

From pies to paper— things will run better on Tri-pedal floors





Tri-pedal striated for heavy loading and wet conditions.

Tri-pedal plain for absolute cleanliness and heavy loads.

If you're in baking or paper making — or any other business where there's heavy work afoot — you should fit a Tri-pedal floor. Tri-pedal tiles are made of iron.

Each unit has a scientifically designed tread eliminating accident-causing slips of the foot. The striations also act as drainage channels — very useful aids where floors need frequent swabbing to maintain full cleanliness. The plain surface tiles are extremely easy to clean and keep free from moisture — you will know which tile type is best suited for certain sections of your factory.

Every plate has a heel underneath at each corner to give it rock-bottom stability. Each plate — and the entire floor — is completely unmoved by the heaviest stresses, strains and tensions. Tri-pedal floors are acid-proof and do not become dangerous underfoot when oils and grease fall on them. Fragile goods can be trundled about on vehicles without risk of damage because the floor is completely jolt-proof. Tri-pedal flooring is fitted at a highly competitive price.

BUTTERLEY **Tri-pedal Iron Paving System**

FOUNDED 1790

Butterley Ironworks, Near Derby. Telephone: Ripley 411 (9 lines). London Office: 9 Upper Belgrave St., S.W.1. Telephone: Sloane 8172/3

Makers since 1790 of railway and other bridges, constructional steelwork, unit bridging, overhead cranes, railway wagons and mine cars, Meehanite castings, iron paving, mining and sheet metal machinery, wrought iron bars, sewage ejectors and pumps, wool washing machinery, Oxygenerators, tonnage oxygen/nitrogen plants, high quality bricks, Aglite lightweight aggregate.

BUT 9652

One of several SR2 Radial Drilling Machines used by the Metal Box Company.

S.R.2

RADIAL DRILLING MACHINES

RICHMOND

Remarkably efficient—

YET SO LOW IN PRICE

In two sizes — 36" and 48" radius — the S.R.2 drills up to 1¼" mild steel 9 spindle speeds; nickel-chrome steel ground gears, heat treated to 100/110 tons per sq. in. Constant-flow pump supplies oil to gearing. Speeds (100-1,500 r.p.m.) selected through easily accessible levers.

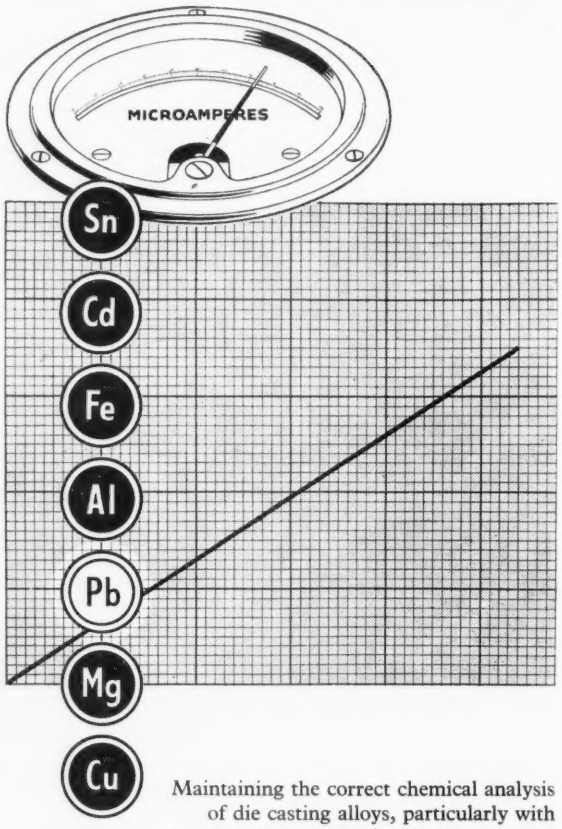
An attractive optional extra available on this machine is a motorised table elevating unit for effortless control.

MIDGLEY & SUTCLIFFE LIMITED : HUNSLET : LEEDS

Tel.: 76032/3

1071

QUALITY CONTROL of pressure die castings



Maintaining the correct chemical analysis of die casting alloys, particularly with regard to impurity limits, is of paramount importance in the production of high quality die castings. Our Laboratory is equipped with one of the few *direct reading spectrographs* in use in this country. As a result the requirements of the B.S.I. Certification Scheme for zinc alloy die castings are far exceeded. Every melt is analysed and the holding furnace of every machine is checked for impurities at least once per shift, enabling any variance from specification to be quickly identified. With the utmost confidence, we can therefore claim to supply castings only of the highest quality.

Quotations, without obligation, from drawings, specifications or samples.

PRESSURE DIE CASTINGS

IN ZINC, ALUMINIUM AND SOFT ALLOYS

SPARKLETS LIMITED

Tottenham, London, N.17

New "BROOMWADE" MV 60

Super torque drill

★ DRILLS & REAMS UP TO 1¼ in. diam.

★ COMPACT

★ IDEAL FOR TAPER REAMING

★ SILENT—VIBRATIONLESS

★ PERFECTLY BALANCED

★ WEIGHS 26 lbs.

The "BROOMWADE" MV 60 drill is supplied with Feed Screw or Grip Handle. Ask for more details or, better still. A DEMONSTRATION.

"BROOMWADE"

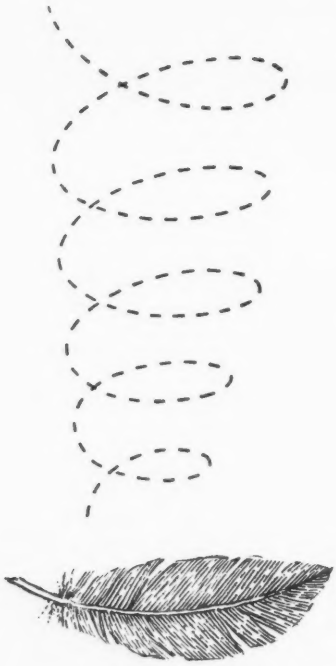
AIR COMPRESSORS & PNEUMATIC TOOLS

Your Best Investment

BROOM & WADE LTD · P.O. BOX No 7 · HIGH WYCOMBE · ENGLAND

Telephone: High Wycombe 1630 (10 lines) *Telegrams: "Broom", High Wycombe, Telex.*

507 SAS



THERE'S A *QUIET* EFFICIENCY ABOUT THE CROID-COOPER METHOD

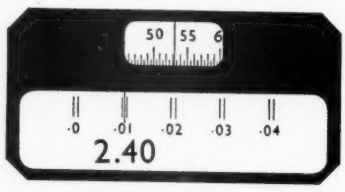
When you reduce noise and vibration you increase efficiency, the efficiency of your workers and of your machines, because vibration wears out machines, too. The Croid-Cooper method holds your machines firmly on a felt base, with an adhesive power of 50 lbs to the square inch, yet you can change your layout overnight because there's no bolting and grouting with Croid-Cooper. And no damaged floors, either. More than a 1,000 factories now use the Croid-Cooper method. May we send you details?

Just four strips of Cooper's MG Felt and some Croid '65' Machine-fixing Glue gives you a firm installation in twelve hours with a holding power of 50 lbs to the square inch.

CROID 65
MACHINE FIXING GLUE
COOPERS
FELT

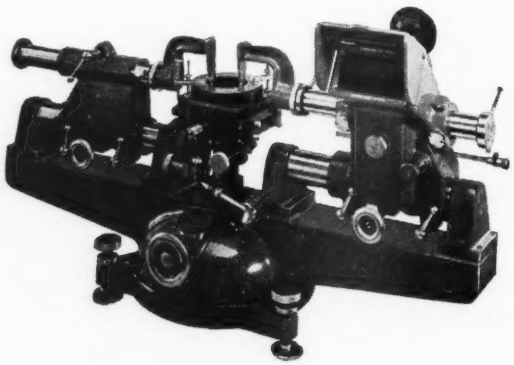
COOPER & CO. (B'HAM) LIMITED
BRYNMAWR **BRECONSHIRE**
TELEPHONE: BRYNMAWR 312

Direct reading to 0.00005 in. on projection screen



FIELD OF VIEW
½ actual size

All measurements with the Microptic Horizontal Measuring Machine are read in large clear figures from a $3\frac{3}{4}$ in. wide screen. Reading is simplified, setting more accurate, eyestrain eliminated. Ideal for use in Testing and Standards Rooms and for routine measuring of all types of internal and external work. Any number of measurements over a four inch range can be made with one standard setting. Capacities: Internal $\frac{7}{16}$ to 10 ins., External 0 to $13\frac{1}{2}$ ins. Metric reading model available. Length 35 ins.; height 22 ins.; width 14 ins.



Write for list IPE/105.

HILGER & WATTS LTD. 98 ST. PANCRAS WAY, LONDON, N.W.1 ***Tel: GULliver 5636***

*Makers of precision optical instruments for analysis, measurement and inspection. Member of the Export Marketing Company—**BESTEC***

HW/108

for the little things that matter-

consult concentric.

WATER PUMPS, STEERING IDLERS, GEAR CHANGE MECHANISMS, BRAKE DRUMS, PUSH RODS, BALL PINS, SHACKLE PLATES, THRUST PLATE ASSEMBLIES, MACHINE COMPONENTS AND PRESSINGS OF ALL KINDS.

Manufacturers of specialised precision engineered components with an established reputation for consistent quality, efficiency and long life — components that are fitted and forgotten, unsung and uncared for, yet — they rarely fail — they're made by Concentric.

concentric manufacturing co.ltd.

TYBURN ROAD. BIRMINGHAM. 24.

NOW— Throw-Away Tips Instead of Time!

EDIBRAC
Throw-away Tips
and Tool Holders
PRICE £3·15·0 including one tip

SAVE PRODUCTION TIME
SAVE GRINDING TIME
SAVE SETTING TIME
Patent applied for

Advantages of these 'Throw-Away' tip tools are as follows:

1 No Regrinding.
2 Accurate and speedy resetting; because of our patent clamping arrangement, it is unnecessary to remove the tool from the tool post, merely slacken the locking screw one turn, and turn the tip round to its new face.
3 Saving in cost of tools. Investigate this EDIBRAC development now—full details on request.

Obtainable jointly from Edibrac Ltd. Centurion Works, Broadheath, Altrincham, Nr. Manchester and Messrs. A. A. Jones & Shipman Ltd., Leicester and their selling agents throughout the world.

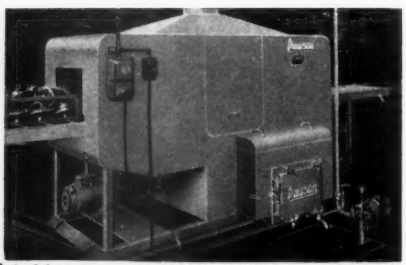
***Think hard—think* EDIBRAC!**

EDIBRAC LIMITED, CENTURION WORKS, BROADHEATH, ALTRINCHAM, NR. MANCHESTER

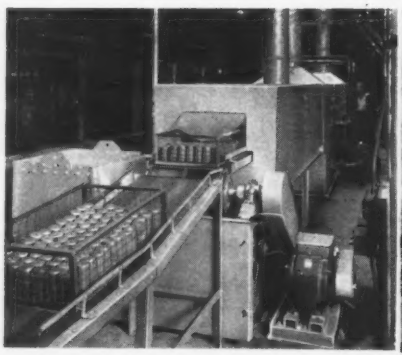
dm EC 26

The most practical plant for Cleaning METAL PARTS

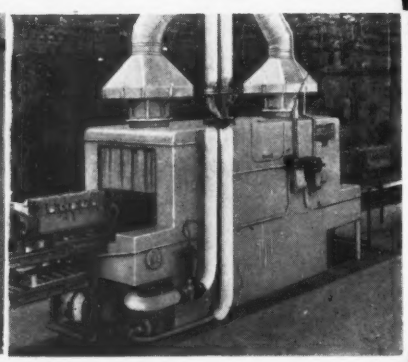
PRIOR TO ASSEMBLY, and BEFORE and AFTER REPAIRS



A 'Junior' type machine supplied to a Midlands Motor Car Works.



Supplied for the washing and drying of Tractor parts. Crank Shafts, Sumps, Pressings, etc.

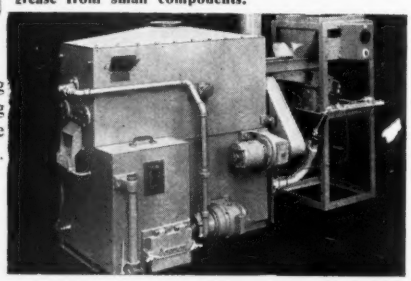


A model 'A' machine washing parts of motor car engines prior to assembly.

Dawson

DE-GREASING AND CLEANING MACHINES

A Rotary Drum machine for removing swarf and grease from small components.



Dawson Metal Parts cleaning machines are supplied for all branches of the engineering industry. Their chief characteristics are robustness of design, small number of working parts and simplicity of operation. Space only permits the illustration of four of the many types of machines built for quick economical washing and drying of Metal Parts.

Sole Distributors

DRUMMOND-ASQUITH (Sales) LTD., King Edward House, New Street, Birmingham.
Telephone—Midland 3431

Manufacturers—DAWSON BROS. LTD., Gomersal, LEEDS
Tel.—Cleckheaton 1080 (5 lines)

London Works—406 Roding Lane, South Woodford Green, Essex. *Tel.—Wanstead 7777 (4 lines)*

ELCONTROL

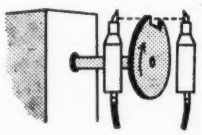
PHOTOELECTRIC CONTROLS

The new range includes a very small viewing head and light source, a little larger than a fountain pen. The new units give a high degree of operational accuracy, and enable photoelectric control to be used where space is severely limited.

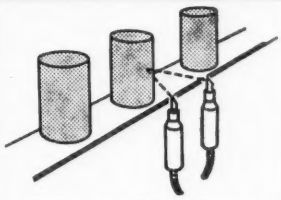
The uses of photoelectric controllers include almost every job where a moving object is concerned — for example counting, batch counting, conveyor blockage control, sorting by size, limit switching, registration control, filling and packaging control and very many others.

Tell us what you want to do and we will gladly help you.

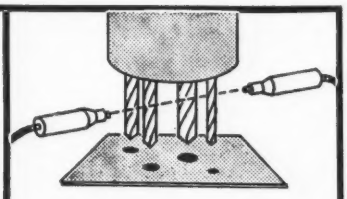
The PR1E photo relay unit having withdrawable chassis.



Showing use of photoswitch as a non-contact limit switch.



A common application for monitoring a conveyor, or for counting, using light reflected from the objects.



The miniature fittings enable fine drills to be continuously watched for breakage.

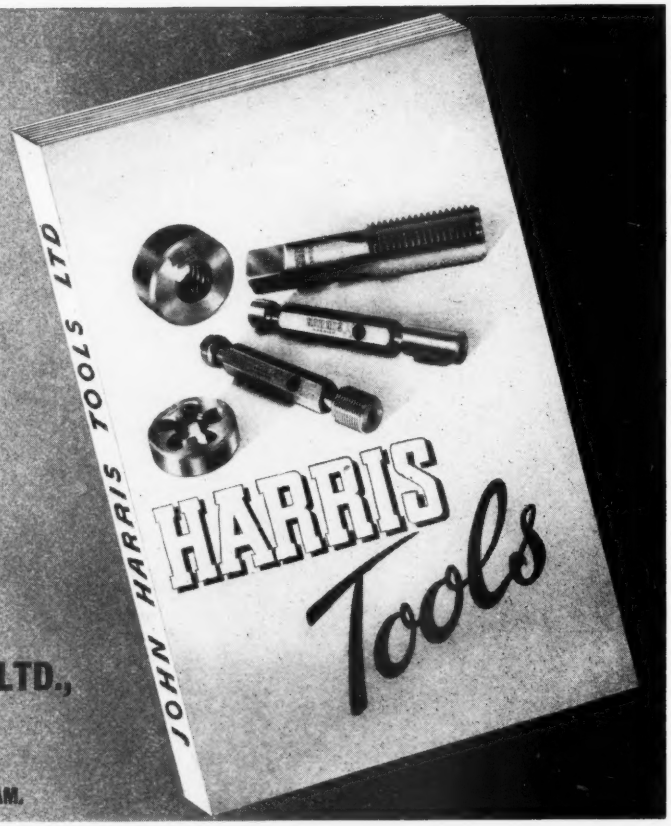
Midland Agents : A. M. Lock & Co. Ltd., 173/4 High Street, Deritend, Birmingham. *Tel. : Birmingham Victoria* 3294

North West Agents : A. M. Lock & Co. Ltd., Prudential Buildings, 79 Union Street, Oldham, Lancs. *Tel. : Main* 6744

Scottish Agents : A. R. Bolton & Co., 3A St. Vincent Street, Edinburgh 3. *Tel. : Edinburgh* 32035

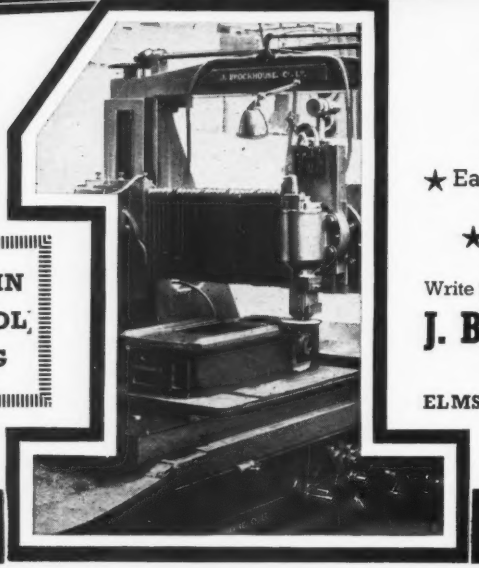
ELCONTROL LTD., 10 WYNDHAM PLACE, LONDON, W.1. *AMBassador 2671.*

Send for your copy now



JOHN HARRIS TOOLS LTD.,
WARWICK,
Telephone: 1221 (6 lines)
and at LONDON, GLASGOW, BIRMINGHAM.

SLIDEWAY GRINDING



SPECIALISTS IN MACHINE TOOL REBUILDING

HEADS FOR HORIZONTAL AND VERTICAL GRINDING WITH THE BROCKHOUSE UNIT GRINDING HEAD AND TRUING DEVICE.

★ Easily adaptable on most standard machines.
★ Rapid and accurate.
★ Slideway Grinding Enquiries invited.

Write for descriptive folder to:

J. BROCKHOUSE & CO. LIMITED
Machine Tool Division
ELMS WORKS : PENN ROAD : WOLVERHAMPTON
Phone: Wolverhampton 23801

AT SETTING

Talking turkey...

Down on the farm Crompton Parkinson stud welding gets down to the job. Tractors and food processing plant, pasteurisers and ploughs—these are typical of the varied assemblies which it helps to make more easily, more quickly and more cheaply. The same applies to all branches of engineering. In virtually every industry that uses metal, C.P. stud welding is at work improving designs, lowering costs and giving productivity a big boost. Care to talk turkey along these lines? We'll be glad to come along with explanation or demonstration—or both!

THE STUD WELDING ORGANISATION

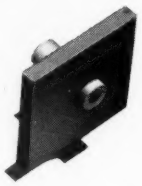
Crompton Parkinson LIMITED

ELECTRICAL EQUIPMENT

1–3, BRIXTON ROAD, LONDON, S.W.9. Telephone: Reliance 7676

STUD WELDING STEPS UP PRODUCTION

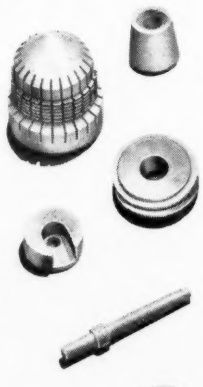
Illustrating the extreme hardness of SINTOX Industrial Ceramic, the photograph on the right shows a ¼ in. dia. tube of SINTOX which, without even chipping, was forced through a ¼ in. thick mild steel plate.



SINTOX IN ENGINEERING

SINTOX MECHANICAL APPLICATIONS

The many mechanical applications of SINTOX industrial ceramic, will be of immense interest to the designer and mechanical engineer. The remarkable resistance to abrasion of SINTOX makes it particularly suitable for such uses as inserts and supports at points where rapid wear presents a problem. Already it has made a name for itself in the Textile industry, where the advent of artificial fibres brought entirely new problems. Thread guides made of SINTOX have been proved to have up to a hundred times the life of those made of hardened steel.



THE HARD CERAMIC **SINTOX**

STAS

Sintox Technical Advisory Service

This service is freely available without obligation to those requiring technical advice on the application of Sintox Industrial Ceramics. Please write for booklet or any information required enclosing blue print if available.

SINTOX IS MANUFACTURED BY **LODGE PLUGS LTD RUGBY**

Cutting Fluids are essential to production . . . . .

No machine shop can carry on production without cutting fluids. For that reason alone it pays to be careful on the matter of selection because the right cutting fluid effects all-round economies — in power consumption, tool life between regrinds and output in unit time. A lot also depends on correct dilution, storage and handling, matters which are adequately dealt with in the Fletcher Miller publication "Cutting Fluids" available free on request.

FLETCHER MILLER

cutting fluids

YOUR PARTNERS IN PRODUCTION

FLETCHER MILLER LTD · ALMA MILLS · HYDE · CHESHIRE

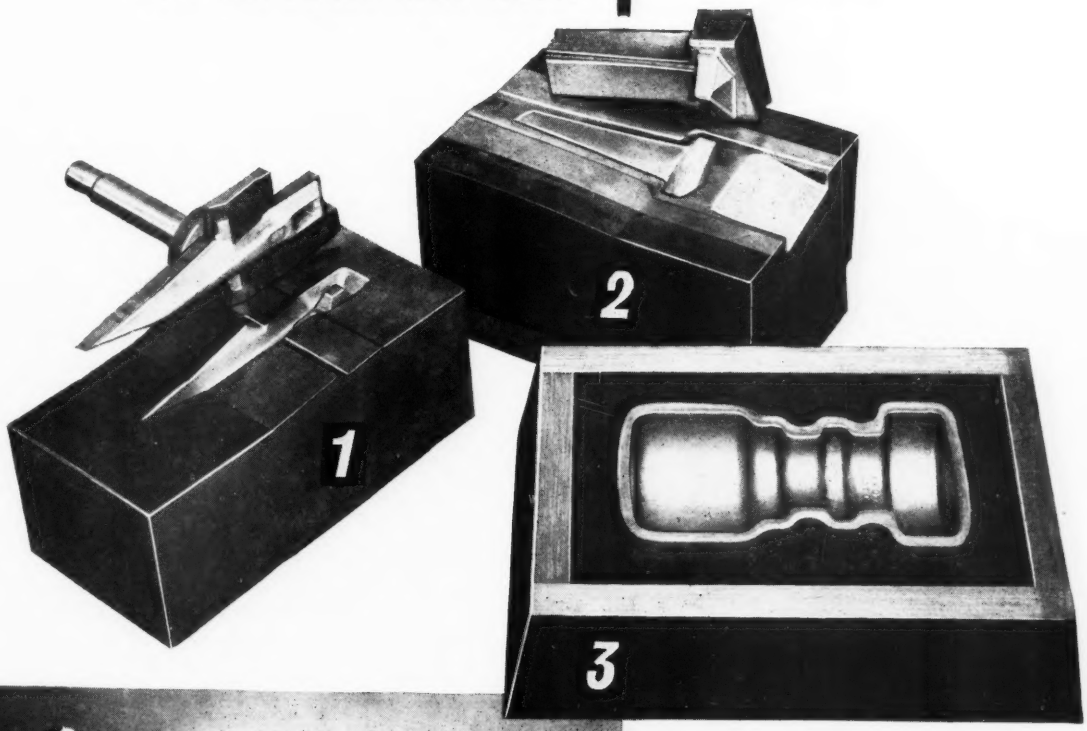
Telephone: Hyde 3471 (5 lines) Telegrams: Emulsion, Hyde

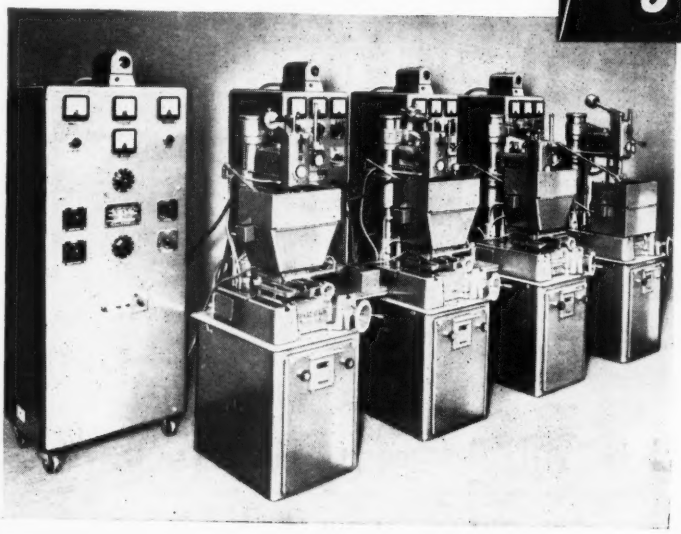
CF/104

The leading manufacturers of spark machining equipment now introduce their latest

Mk III Model

6·5 kW





A battery of four Sparcatron heads operated from one main control unit in conjunction with three auxiliary control units.

1 Harvester Tine forging die machined from the solid by Spark Machining in the hardened state

2 Jet Compressor Blade Forging Die reconditioned by Spark Machining

3 Layshaft Forging Die, preformed and finished by Spark Machining

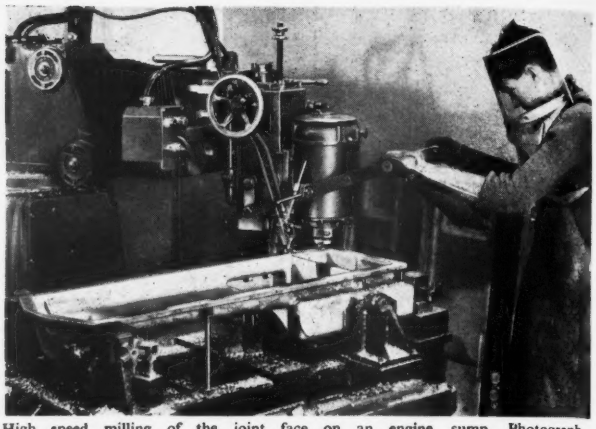
SPARCATRON

Manufactured by

IMPREGNATED DIAMOND PRODUCTS LIMITED
GLOUCESTER · ENGLAND

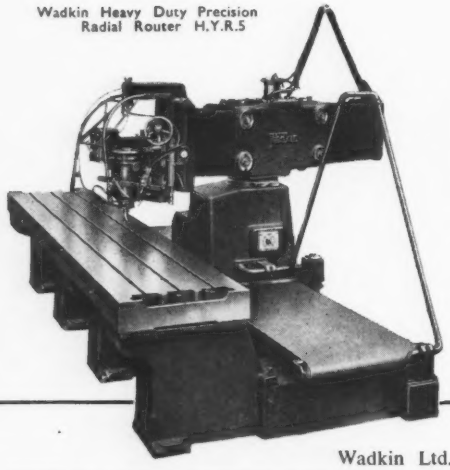
Sole Agents for the United Kingdom · BURTON, GRIFFITHS & CO. LTD KITTS GREEN BIRMINGHAM 33

Revolutionising machining times on NON-FERROUS METALS



High speed milling of the joint face on an engine sump. Photograph by courtesy of Messrs. Rolls-Royce Ltd., Oil Engine Division, Derby.

Wadkin Heavy Duty Precision Radial Router H.Y.R.5



The new high speed milling techniques developed by Wadkin guarantee light alloy components being machined in the fastest possible times. Unlike conventional machine tools, Wadkin employ cutting speeds up to 18,000 r.p.m. This ensures remarkably free cutting, an extremely fine finish, and a metal removal rate of 20 cu. ins. per minute. It's a performance that, in some instances, has cut down production times by more than 80%. If you are face milling, pocketing or profiling non-ferrous castings or sheets it would pay you to investigate.

Wadkin

Telephone: Leicester 67114 — *Telephone: MAYfair 7048-9*

Wadkin Ltd., Green Lane Works, Leicester. London Office: 62 Brook St., London W.1

PATENT CALIPER GAUGE MODEL 52

Each month one of the seven main advantages of this fine precision instrument will be described.

- Many different gauging positions can be obtained.
- ★● The anvils are set so that they do not roll.
- All shearing action is eliminated.
- Particularly suitable for gauging shouldered work.
- Can be used for either left or right hand threads.
- Particularly suitable for the gauging of acme forms of thread.
- Can be supplied for "GO" only, or "NOT GO" only, or both "GO" & "NOT GO" combined.

NOTE THIS MONTH'S IMPORTANT FEATURE

★ **THE ANVILS ARE SET SO THAT THEY DO NOT ROLL**

As the anvils are set and do not roll, a better feel of the component passing through the gauge is obtained than is the case with the roller type.

Write today for a descriptive leaflet to:-

HORSTMANN — **THE HORSTMANN GEAR CO. LTD., NEWBRIDGE WORKS. BATH. ENGLAND.**

TEL: BATH 7241
GRAMS: HORSTMANN BATH

Announcing

the revolutionary

cost-cutting

CROSLAND

Blank & Pierce Service For Short-Run Production

If you need small (as small as you like!) quantities of blanks, forget about tooling, and simply send your drawings and specifications to the Crosland Blank and Pierce Service. It will give you prompt delivery of well-finished blanks at surprisingly inexpensive rates. Its secret lies in unique tooling and production techniques.
Write at once for estimates by return.

William Crosland Ltd.

BREDBURY, Nr. STOCKPORT, CHESHIRE

TELEPHONE: WOODLEY 2621 (3 lines)

HEAT TREATMENT

- Capacity for case-hardening is now available in the most modern heat-treatment plant in London
- Gas or pack carburising with full metallurgical control over all operations
- Gleason quenching press equipment for pieces up to 36″ dia. plus wide experience in the control of distortion
- Flame-hardening of gears up to 10 ft. dia. with latest electronically controlled equipment

E.N.V. ENGINEERING COMPANY LIMITED
HYTHE ROAD · WILLESDEN · N.W.10
Tel: LADbroke 3622–3–4–5–6

AP 79

LET US BE YOUR MACHINE SHOP

WE INVITE YOUR ENQUIRIES FOR:

Capstan, turret and centre lathe work: Milling—all types—internal, surface and universal grinding. GSIP jig-boring, drilling, shaping, honing, etc. also for tool work. Ours is a complete machine shop to meet your every need.

A.I.D. and A.R.B. Approved.

MARSDEN & SHIERS LTD.
DAVIS ROAD · CHESSINGTON · SURREY
Phone ELMBRIDGE 5333-4

600 Group Service
to the
POWDER METALLURGY INDUSTRY

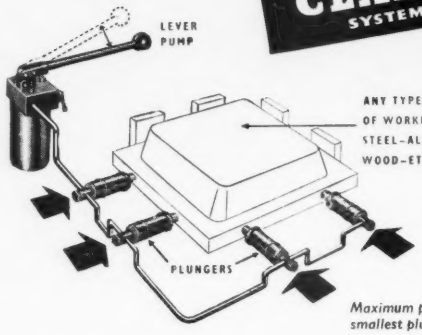
We are suppliers of specialised plant, e.g. mechanical and hydraulic presses, sintering furnaces, mixers and sieves.

Also "Sintrex" Atomised Iron Powder, Electrolytic Iron Powder and Stainless Steel Powders for engineering and electromagnetic components.

GEORGE COHEN (THE 600 GROUP)
SONS AND COMPANY LIMITED
Wood Lane London W.12 Telephone: SHEpherds Bush 2070
Telegrams: Coborn Telex London

BIGGEST TIME & MONEY SAVER in WORK CLAMPING

NEWTON Hydraulic CLAMP SYSTEM



These plungers can exert a pressure of from 800lbs—4 tons.

Can be used in groups of any number.

Maximum pressure with smallest plungers
Easily adaptable to any fixture design
Simultaneous plunger action
Minimum floor to floor time

POWER JACKS LIMITED
VALETTA RD. · ACTON · LONDON · W3
TEL SHEPHERDS BUSH 3403 (4 lines) GRAMS NEWSORBER EALUX LONDON

Send today for illustrated brochure N1/243

NOW STANDARDISING

ON W M LATHES

Westminster Airways Servicing Ltd

GOSPORT, HANTS.

Since 1951, when they installed their first '70' Junior Lathe, Westminster Airways Servicing Ltd., have steadily added to their W & M line. Today they have five '70' Junior Lathes and two '85' Senior Lathes, all employed "with complete satisfaction" on intricate high precision Aircraft Prototype and Tool Work.

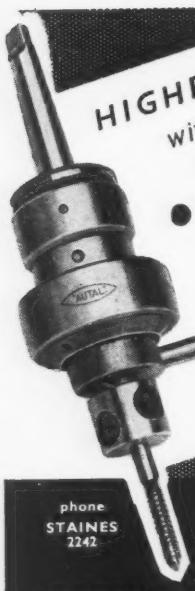
In work of this kind, which demands such high standards of accuracy and reliability, "complete satisfaction" is always the aim of W & M.

WOODHOUSE & MITCHELL

WAKEFIELD ROAD · BRIGHOUSE · YORKS

PHONE: BRIGHOUSE 627 (3 LINES) — GRAMS: 'WOODHOUSE BRIGHOUSE'

WM21



HIGHER SPEEDS with GREATER PRECISION!

● High speed reverse

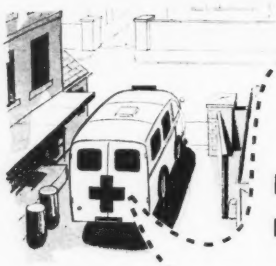
Tap breakage eliminated
Infinitely variable torque
No special collets
Uses standard hand taps
Attachment for button dies
Five sizes from $\frac{1}{16}$" to $1\frac{1}{2}$"
four non reverse models

phone STAINES 2242

The AUTAL TAPPING HEAD

OPTICAL & MECHANICAL DEVICES

3 & 4 WESTHEAD CHAMBERS · GEORGE ST.
KINGSTON ROAD · STAINES · MIDDLESEX



BUT IT'S BETTER TO INSTALL UDAL PRESS GUARDS

Many a pressworker exposes himself to danger because the guard slows him down, irritates him, frustrates him. That's one good reason for fitting Udal 'Fastrip' guards. Guard and clutch are synchronised to ensure split-second timing, allowing the highest standard of safety without impeding production. Send for details today.

J. P. UDAL LIMITED

INTERLOCK WORKS, COURT RD.
BIRMINGHAM 12. TEL: CAL 3114

Udal PRESS GUARDS

THE FIRM WITH HALF-A-DOZEN JIG BORERS for

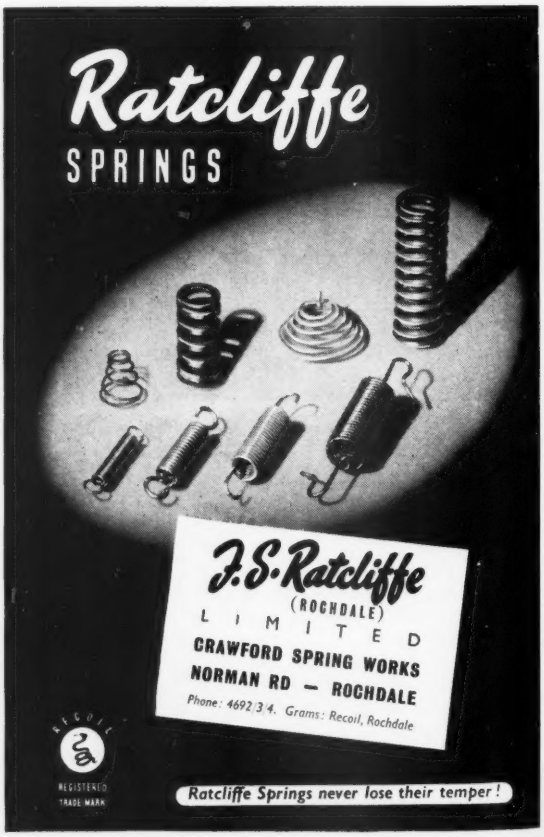
PRESS TOOLS

etc.

HIGH SPEED SERVICE TOOL CO. LTD.
Maple Road, Surbiton, Surrey. Elmbridge 1135-7

STUDER PROFILE GRINDING A SPECIALITY

Ratcliffe SPRINGS



J.S. Ratcliffe (ROCHDALE) LIMITED
CRAWFORD SPRING WORKS
NORMAN RD — ROCHDALE
Phone: 4692/3/4. Grams: Recoil, Rochdale

REGD. TRADE MARK

Ratcliffe Springs never lose their temper!

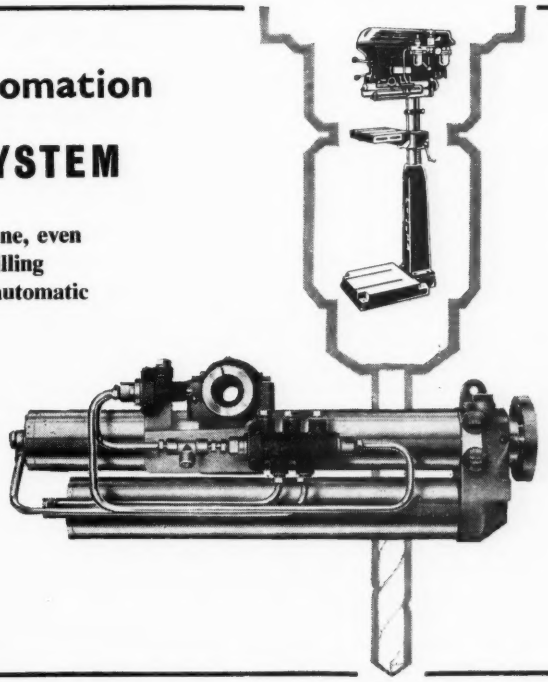
AUTOMATION

built up UNIT BY UNIT

Everyone can afford automation

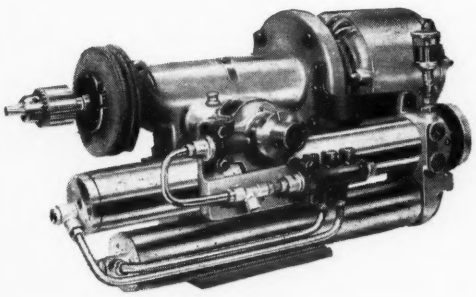
THE PACERA SYSTEM

The Pacera system makes it available to everyone, even in a small way of business, because existing Drilling Machines can nearly always be adapted for automatic operation.



THE PACERA MAXAM AIR-HYDRAULIC FEED UNIT

Converts drilling machines from manual to automatic operation. It can be pre-set in a matter of minutes to give perfect and accurate performance over the longest of runs, and to be economical and impersonally accurate on short runs. It will convert the kind of drilling machine you have.



PACERA AUTOMATIC UNIT DRILLING HEADS

Can be mounted, not only horizontally but in most other positions. They may be controlled simply and positively in single or multiple installations. Loading, locating, clamping and ejecting are readily "tied-in" with the drilling stroke. They are suitable for tapping with standard attachments.

PACERA

Automation means big business, even for the small firm. Our technical representatives are always ready to advise on even the smallest beginnings — without obligation.

★ *Write for new illustrated brochure. "A Guide to Increased Production".*

All "PACERA" Machines are made in England, at our factory in Slough.

W. J. MEDDINGS LTD.,

16 BERKELEY STREET, LONDON, W.1. Telephone: MAYfair 6417

INDEX TO ADVERTISEMENTS

	Page
Acme Conveyors, Ltd.	xxxiv
Acme Ventilating, Ltd.	—
Acrow (Engineers), Ltd.	—
Adcock & Shipley, Ltd.	viii
Aero Research, Ltd.	xxi
Allen, Edgar, & Co. Ltd.	x
Aluminium Wire & Cable Co. Ltd	—
Andrews, Toledo, Ltd.	—
Archdale, James & Co. Ltd.	lxxvii
Armstrong Patents Co. Ltd.	—
Arrow Electric Switches, Ltd.	—
Asquith, William, Ltd.	xlviii
Associated Steels & Tools Co. Ltd.	—
Baker, C., of Holborn, Ltd.	—
Barber & Colman, Ltd.	—
Barraclough, R. W., Ltd.	—
Bawn, W. B. & Co. Ltd.	lxx
Benton & Stone, Ltd.	—
B.I.P. Chemicals, Ltd.	—
Birlec, Ltd.	—
Birmingham Aluminium Casting (1903) Co. Ltd.	iii
Black & Decker, Ltd.	xxviii
Bolton Railway Wagon & Ironworks Co. Ltd.	xl
Bratby & Hinchliffe, Ltd.	—
Bray Accessories, Ltd.	—
British Aero Components, Ltd.	xxxiii
British Electrical Development Association, The	lx
British Oxygen Gases, Ltd.	vi
British Thomson-Houston Co. Ltd.	—
British Timken, Ltd.	—
Bristol Repetition, Ltd.	—
Broadbent, Henry, Ltd.	—
Brockhouse, J., & Co. Ltd.	lxxxvi
Broom & Wade, Ltd.	lxxxi
Brown, David, Corpn. (Sales) Ltd., The	lxxii
Brown & Ward, Ltd.	—
B.S.A. Tools, Ltd.	xxix
Burton Griffiths & Co. Ltd.	xxix
Butler Machine Tool Co. Ltd., The	—
Butterley Co. Ltd., The	lxxix
Carborundum Company Ltd., The	v
Catmur Machine Tool Corpn., Ltd.	—
Cementation (Muffelite) Ltd.	lii
Central Tool & Equipment Co. Ltd.	—
Churchill, Charles & Co. Ltd.	lviii
Churchill Machine Tool Co. Ltd.	xlvi
Clarkson (Engineers), Ltd.	xi
Climax Rock Drill & Eng. Works Ltd.	xv
Cohen, Geo., Sons & Co. Ltd.	xcii
Concentric Manufacturing Co. Ltd.	lxxxiii
Consolidated Zinc Corporation (Sales), Ltd.	xliii
Cooper & Co. (Birmingham), Ltd.	lxxxii
Coventry Climax Engines, Ltd.	*Outside Back Cover*
Coventry Gauge & Tool Co. Ltd.	—
Cow, P. B., & Co. Ltd.	—
Croda, Ltd.	—
Crofts (Engineers), Ltd.	xxxvi
Crompton Parkinson, Ltd.	lxxxvii
Crosland, William, Ltd.	xci
Darwins Bright Steels, Ltd.	lxvi
Darwins Group, The	lxvi
Davis, Stuart, Ltd.	—
Dawe Instruments, Ltd.	—
Dawson Bros., Ltd.	lxxxiv
Dean Smith & Grace, Ltd.	iv
Dowding & Doll, Ltd.	—
Drummond Asquith (Sales), Ltd.	—
Drummond Bros., Ltd.	xlix
Dyson & Co. Enfield (1919), Ltd.	—
E.M.I. Electronics, Ltd.	—
E.N.V. Engineering Co. Ltd.	xlvii, xcii
Edibrac, Ltd.	lxxxiv
Elcontrol, Ltd.	lxxxv
Elgar Machine Tool Co. Ltd.	—
Elliott Brothers (London), Ltd.	—
English Electric Co. Ltd., The	lix
English Steel Tool Corporation, Ltd.	—
Exors of James Mills, Ltd.	—
Fawcett-Finney, Ltd.	—
Fescol, Ltd.	xxv
Firth Brown Tools, Ltd.	—
Firth, Thos. & Brown, John, Ltd.	lxiii
Flame Hardeners, Ltd.	—
Fletcher Miller, Ltd.	lxxxviii
Ford Motor Co. Ltd.	lvii
Fox, Samuel, & Co. Ltd.	—
Fractional H.P. Motors, Ltd.	—
Fraser, Andrew, & Co. Ltd.	—
Gledhill-Brook Time Recorders, Ltd.	—
Glostics, Ltd.	lvi
G.P.A. Tools & Gauges, Ltd.	—
Guest, Keen & Nettlefolds (Midlands), Ltd.	—
Guylee, Frank, & Son, Ltd.	lxxiv
Hale & Hale, Ltd.	—
Harrison, T. S. & Sons, Ltd.	—
Harris Tools, John, Ltd.	lxxxvi
Heenan & Froude, Ltd.	—
Herbert, Alfred, Ltd.	li
High Speed Service Tool Co. Ltd.	xciv
Hilger & Watts, Ltd.	lxxxii
Holman Bros., Ltd.	xiii
Holt, James (Engineers), Ltd.	—
Hordern, Mason & Edwards, Ltd.	—
Horstmann Gear Co. Ltd., The	xc
Hymatic Engineering Co. Ltd., The	—
Impregnated Diamond Products, Ltd.	liii
Integra, Leeds & Northrup, Ltd.	—
Intermit, Ltd.	—
Jessop, Wm., & Sons, Ltd.	xxxv
Johansson, C. E., Ltd.	lv
Jones, A. A., & Shipman, Ltd.	lxviii
Kaye, E. & E., Ltd.	—
Kearns, H. W., & Co. Ltd.	—
Kenilworth Manufacturing Co. Ltd.	—
King, Geo. W., Ltd.	—
Kirkstall Forge Engineering Ltd.	—
Lang, John & Sons, Ltd.	xlv
Lang Pneumatic, Ltd.	xxii
Lapointe Machine Tool Co. Ltd.	lxv
Ley's Malleable Castings Co. Ltd.	—
Lincoln Electric Co. Ltd., The	—
Lloyd, Richard, Ltd.	lxxiv
Lodge Plugs, Ltd.	lxxxviii
London Oil Refining Co. Ltd., The	—
Lund, John, Ltd.	lxxiii
Macready's Metal Co. Ltd.	xl
Magnesium Elektron Co. Ltd.	xxxvii
Manganese Bronze & Brass Co. Ltd.	xix
Marbaix, Gaston E., Ltd.	—
Markland Scowcroft, Ltd.	xli
Marsden & Shiers, Ltd.	xcii
Marsh Bros., & Co. Ltd.	lxxvi
Martonair, Ltd.	lxxv
Meddings, W. J., Ltd.	xcv
Metropolitan-Vickers Electrical Co. Ltd.	—
Midgley & Sutcliffe, Ltd.	lxxx
Midland Iron Co. Ltd., The	—
Mills Scafforld Co. Ltd.	—
Mining & Chemical Products, Ltd.	xxx
Mobil Oil Co. Ltd.	xii
Monks & Crane, Ltd.	vii
Morris, B. O., Ltd.	—
Napier, D., & Son, Ltd.	—
National Industrial Fuel Efficiency Service	—
Neill, James & Co. (Sheffield), Ltd.	xvii
Newall, A. P., & Co. Ltd.	lxxii
Newall Group Sales, Ltd.	lxi
New Conveyor Co. Ltd.	xxxii
Norton Grinding Wheel Co. Ltd.	—
Ofrex Group	—
Opperman Gears Ltd.	xx
Optical & Mechanical Devices	xciv
Osborne, Samuel, & Co. Ltd.	lxiv
Park Gate Iron & Steel Co. Ltd.	*Inside Back Cover*
Parkinson, J., & Son (Shipley), Ltd.	—
Paterson Hughes Eng. Co. Ltd.	—
Philips Electrical, Ltd.	lxxi
Plannair, Ltd.	liv
Power Jacks, Ltd.	xcii
Precision Grinding, Ltd.	—
Production Tool Alloy Co. Ltd., The	lxxvi
Pryor, Edward, & Son, Ltd.	—
Rack Engineering, Ltd.	xvi
Rank-Xerox, Ltd.	—
Ransomes, Sims & Jefferies, Ltd.	—
Ratcliffe, F. S. (Rochdale), Ltd.	xciv
Rawlplug Co. Ltd., The	xxxviii
Reavell & Co. Ltd.	lxxviii
Reliance Gear & Eng. Co. (Salford), Ltd.	—
Rockwell Machine Tool Co. Ltd.	xxiii
Rowland, F. E., & Co. Ltd.	—
Russell, S., & Sons, Ltd.	—
Ryder, Thos., & Son, Ltd.	lxix
Saville, J. J., & Co. Ltd.	xxxv
Scrivener, Arthur, Ltd.	—
Selson Machine Tool Co. Ltd., The	—
Sentinel (Shrewsbury), Ltd.	xiv
Sheffield Forge & Rolling Mills Co. Ltd.	—
Shell-Mex & B.P., Ltd.	—
Slack & Parr, Ltd.	l
Snow & Co. Ltd.	xxxix
Société Genevoise, Ltd.	xxvi, xxvii
Sogenique (Service), Ltd.	—
Sparcatron	lxxxix
Sparklets, Ltd.	lxxx
Square, D., Ltd.	ix
Steel, Peech & Tozer	—
Sternol, Ltd.	lxxviii
Sunbeam Anti-Corrosives, Ltd.	—
Swift, Geo., & Sons, Ltd.	—
Swift Summerskill, Ltd.	—
Talbot Tool Co. Ltd., The	—
Technology	xviii
Teleflex Products Limited	lxx
Town, Frederick & Sons, Ltd.	—
Turner Machine Tools, Ltd.	—
Udal, J. P., Ltd.	xciv
Unbrako Socket Screw Co. Ltd.	—
United Steel Companies, Ltd., The	—
Universal Tools, Ltd.	—
Vacu-Blast, Ltd.	—
Van Moppes & Sons (Diamond Tools), Ltd.	—
Vaughan Associates, Ltd.	lxvii
Wadkin, Ltd.	xc
Wakefield-Dick Industrial Oils, Ltd.	xxxi
Ward, H. W., & Co. Ltd.	xliv
Ward, Thos. W., Ltd.	—
Webster & Bennett, Ltd.	xxiv
Wickman, Ltd.	xlii
Wild-Barfield Electrical Furnaces, Ltd.	lxii
Woodhouse & Mitchell	xciii

All communications regarding advertisements should be addressed to the Advertising Managers, T. G. Scott & Sons, Ltd., 1 Clement's Inn London, W.C.2. Telephone: HOLborn 4743.
Printed by Maxwell, Love & Co. Ltd., 309 - 317 Borough High Street, London, S.E.1.

rnal

Page

—
xvii
Lxxii
Lxi
xxxii
—

—
xx
xciv
Lxiv

Cover

—
—
Lxxi
Liv
xcii
—
Lxxvi
—

xvi
—
—
xciv
xxxviii
Lxxviii

—
xxiii
—
—
Lxix

xxxv
—
—
xiv

—
L
xxxix
vi, xxvii
—
Lxxxix
Lxxx
ix
—
Lxxviii
—
—
—

—
xviii
Lxx
—
—

xciv
—
—
—

—
—
Lxvii

xc
xxxi
xLiv
—
xxiv
xLii

Lxii
xciii